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A Sierra Monitor Company

**Driver Manual**  
(Supplement to the FieldServer Instruction Manual)

**FS-8700-21 LonWorks**

**APPLICABILITY & EFFECTIVITY**

**Effective for all systems manufactured after May 1, 2001**

|                           |             |
|---------------------------|-------------|
| <b>Driver Version:</b>    | <b>1.20</b> |
| <b>Document Revision:</b> | <b>0</b>    |

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## **1. LonWorks Driver Description**

The LonWorks driver allows the FieldServer to transfer data to and from devices using LonWorks protocol. The FieldServer can emulate either a Server or Client. The FS-B4011 FieldServer is supplied with a LonWorks Card, while the FS-B2011 and FS-B30 Series FieldServers have a built-in LonWorks Interface. A Fieldbus connection is available on the FieldServer. The FS-B30 and FS-B4011 can handle up to 4096 Network Variables and the FS-B2011 up to 1000 which can be of the Standard Network Variable Types (SNVT) and/or User-defined Network Variable Types (UNVT).

### **1.1. Clients and Servers**

The FieldServer functions as a Client when polling or sending updates on the LonWorks network and as a Server when being polled or receiving updates. The FieldServer can be bound to a maximum number of 15 LonWorks nodes. The FieldServer recommended print limit is 1096.

### **1.2. Network Variable Updates and Polls**

On LonWorks networks, information is transferred using Network Variable Updates and Network Variable Polls. The Client requests Network Variables from the Server using NV Polls and NV Updates occur when a Client sends Network Variables to a Server.

### **1.3. Network Management**

The FieldServer is able to set its own Domain, Subnet and Node ID at start-up using the FieldServer configuration file. Alternatively, the FieldServer is capable of being commissioned and bound by Network Management Tools such as LonMaker® - see Appendix A.9 for further information.

### **1.4. Explicit and Implicit Addressing**

Clients can address Servers using explicit or implicit addressing. Clients using explicit addressing obtain their data transfer parameters directly from the FieldServer configuration file. The FS-B30 and FS-B4011 can handle a maximum of 4096 explicitly addressed nodes and the FS-B2011 up to 1000. Implicit addressing is used when a Network Management Tool such as LonMaker® is used to connect a FieldServer to other LonWorks nodes - the FieldServer is assigned its data transfer (binding) parameters by the Network Management Tool.

### **1.5. External Interface Files**

At start-up the FieldServer creates an external interface file (XIF) called fServer.xif based on the configuration file. The XIF for the default configuration (Primserv.xif) is included on the driver diskette shipped with the FieldServer. The FieldServer differs from most other LonWorks drivers in that it is configurable and therefore its XIF is not fixed for all applications. The list of points available to the network will vary depending on the other networks connected to the FieldServer, and the requirements of the particular application. The recommended procedure for obtaining the XIF file for the FieldServer is to upload it.

### **1.6. Device Resource files**

The STANDARD device resource file covers FieldServer data type support. All Standard Network Variable Types (SNVTs) in this file are available to the user. These SNVTs are listed in Appendix A.3. Please note that due to the sophisticated nature of LonWorks

variables, it may not always be possible to typecast the full information supplied in a LonWorks variable to a simple Data Type contained in another protocol. The FieldServer has Move and Logic functions available which would allow the LonWorks variable to be split up and passed to separate simple data types, thus preventing information loss. The FieldServer supports the sending and receiving of User-defined Network Variable Types (UNVTs) on the LonWorks Network. An UNVT is simply implemented as an array of bytes of user-defined length.

### **1.7. Functional Blocks and LonMark Objects**

The FieldServer provides the capability of defining multiple functional blocks, but only a single LonMark object\*. The user can create multiple functional blocks or a LonMark object by filling out the Node Self-Documentation String, and the respective Network Variable Self-documentation String fields in the FieldServer configuration file.

### **1.8. Network Variable Aliases**

The FieldServer currently supports a default of 63 network variable aliases to avoid network variable connection constraints. This number may be increased to a maximum of 4096.

### **1.9. ATMI ACM enhancement**

4096 Network Variables can be supported

Update rate of "acknowledged NV updates" is at least 25 per second.

### **1.10. Configuration Properties**

Configuration Properties (CP's) characterize the behavior of a device in the system. Network installation tools realize this attribute and provide database storage to support maintenance operations. If a device fails and needs to be replaced, the configuration property data stored in the database is downloaded into the replacement device to restore the behavior of the replaced device in the system. Configuration properties are implemented on the FieldServer through configuration network variables. User-defined configuration property types are not supported. Appendix A.13 provides a list of standard configuration property types that are supported.

The information that follows describes how to expand upon the factory defaults provided in the configuration files included with the FieldServer.

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\* One can only create LonMark Interoperable Products (see [www.lonmark.org](http://www.lonmark.org)) by using LonMark objects.

## 2. Driver Scope of Supply

### 2.1. Supplied by FieldServer Technologies for this driver

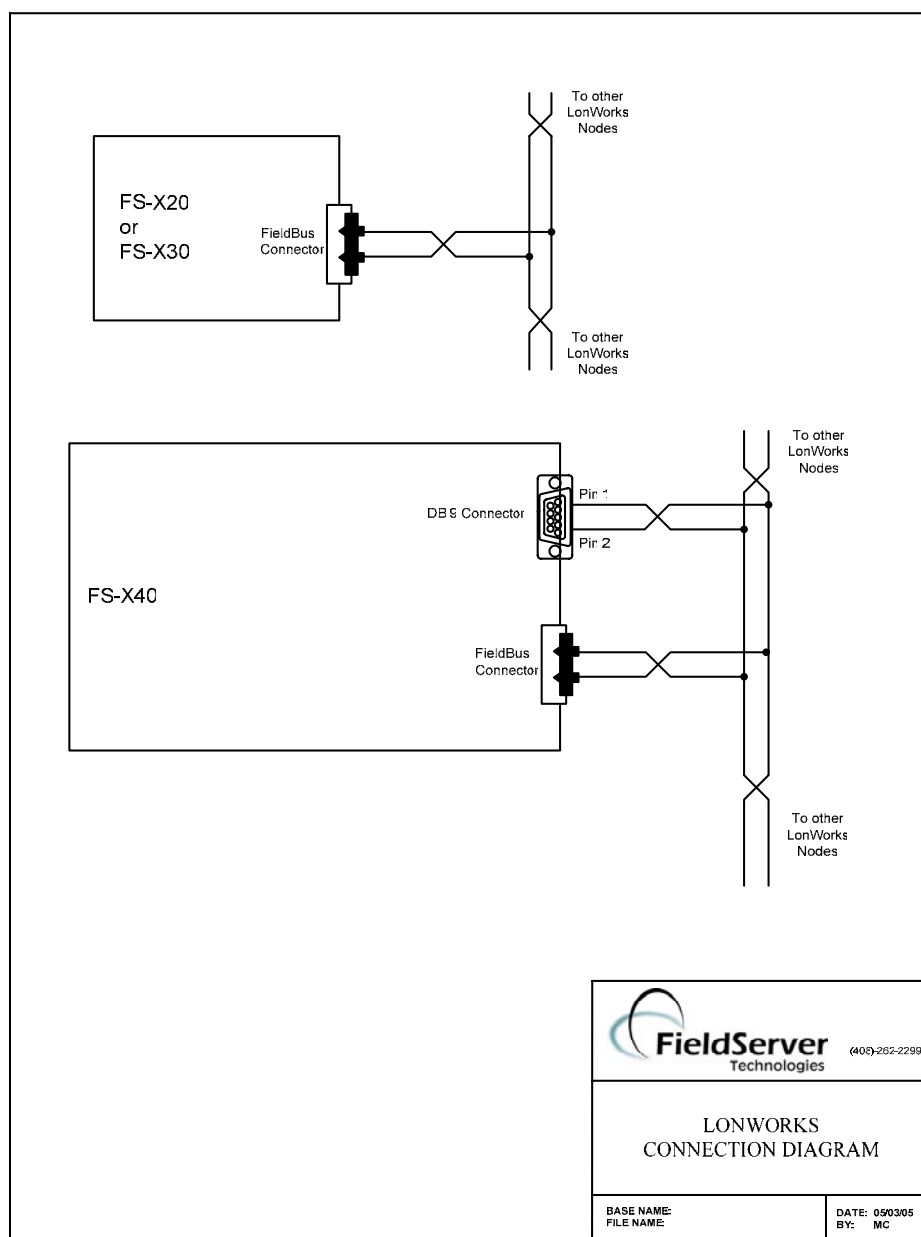
| FieldServer Technologies<br>Part # | Description    |
|------------------------------------|----------------|
| FS-8700-21                         | Driver Manual. |

### 2.2. Provided by the Supplier of 3<sup>rd</sup> Party Equipment

| PART # | DESCRIPTION                                                                                     |
|--------|-------------------------------------------------------------------------------------------------|
| N/A    | LonMaker® Integration Tool from Echelon Corporation (Optional Network Management Software)      |
| N/A    | LonWatcher from Distech Controls Inc. (Optional Network Management Software)                    |
| N/A    | Circon System Integrator from Circon Systems Corporation (Optional Network Management Software) |
| PCC10  | PCCard LonWorks Adapter (Optional)                                                              |

### 3. Hardware Connections

LonWorks devices are available with several different physical interfaces. The screw plug supplied with the FieldServer LonWorks interface will connect the FieldServer to the FTT-10 network. The 9 pin D-connector can also be used to connect to the network (FS-B4011 only). The 2-wire twisted-pair connection to the network is polarity insensitive. The FTT-10 network is a free topology network which supports star, loop and/or bus wiring connections. Please refer to the FTT-10A Free Topology Transceiver User's Guide from Echelon Corporation for recommended wiring practices if necessary. The connection diagram below shows how the FieldServer FS-B2011, FS-B30 and FS-B4011 are connected to a LonWorks network:



Configure the remote LonWorks devices according to manufacturer's instructions.

### 3.1. Service Pin

The service pin is used to commission the FieldServer onto the network using a LonWorks Network Management tool. On FS-X20 FieldServers the node's unique Neuron ID will be displayed on the Error Screen of the RUINet utility with every service pin press.

### 3.2. The LonWorks Adapter Card (FS-X40 only)

#### 3.2.1. Port Address Switch

The LonWorks driver has been configured to access the LonWorks card at ISA port address 340 hex. This is the default setting for the card, and the DIP switches must not be modified. The DIP switch setting on the card is as follows:

| Switch | Setting |
|--------|---------|
| 1      | ON      |
| 2      | ON      |
| 3      | OFF     |
| 4      | ON      |
| 5      | OFF     |
| 6      | OFF     |
| 7      | OFF     |
| 8      | OFF     |

## 4. Configuring the FieldServer as a LonWorks Client

For a detailed discussion on FieldServer configuration, please refer to the FieldServer Instruction manual. The information that follows describes how to expand upon the factory defaults provided in the configuration files included with the FieldServer (See “.csv” sample files provided with the FieldServer).

This section documents and describes the parameters necessary for configuring the FieldServer to communicate with a LonWorks Driver Server.

### 4.1. FieldServer<sup>1</sup>

| Section Title  |                                                                                                         |                      |
|----------------|---------------------------------------------------------------------------------------------------------|----------------------|
| FieldServer    |                                                                                                         |                      |
| Column Title   | Function                                                                                                | Legal Values         |
| System_Address | Network Node ID when domain table setup is required.                                                    | 1-127                |
| Title          | Node self-documentation string and/or Network domain and subnet ID when domain table setup is required. | Up to 40 characters. |

#### Example

```
// FieldServer

FieldServer
System_Address,          Title
10,                      “:D48:S01:&3.2@1;WaterTempSensor”
```

### 4.2. Data Arrays/Descriptors

Note that in the tables, \* indicates an optional parameter, with the bold legal value being the default.

| Section Title     |                                                                                                                                            |                                                                     |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Data_Arrays       |                                                                                                                                            |                                                                     |
| Column Title      | Function                                                                                                                                   | Legal Values                                                        |
| Data_Array_Name   | Provide name for Data Array                                                                                                                | Up to 15 alphanumeric characters                                    |
| Data_Array_Format | Provide data format. Each Data Array can only take on one format.                                                                          | FLOAT, BIT, UINT16, SINT16, PACKED_BIT, PACKED_BYTE, UINT32, SINT32 |
| Data_Array_Length | Number of Data Objects. Must be larger than the data storage area required by the Map Descriptors for the data being placed in this array. | 1-10,000                                                            |

<sup>1</sup> Refer to Appendix A.8 for further information

**Example**

|                  |              |                   |
|------------------|--------------|-------------------|
| // Data Arrays   |              |                   |
| Data_Arrays      |              |                   |
| Data_Array_Name, | Data_Format, | Data_Array_Length |
| DA_AI_01,        | Uint16,      | 200               |
| DA_AO_01,        | Uint16,      | 200               |
| DA_PI_01,        | Float,       | 10                |
| DA_FO_01,        | Float,       | 10                |

**4.3. Client Side Connection Descriptions**

| Section Title   |                            |                                                |
|-----------------|----------------------------|------------------------------------------------|
| Connections     |                            |                                                |
| Column Title    | Function                   | Legal Values                                   |
| Adapter         | Adapter Name               | LonWorks                                       |
| Protocol        | Specify protocol used      | LonWorks                                       |
| Connection_Type | Specify Network Management | <b>LonMaker®</b> , LonWatcher, Circon_SI, None |

**Example**

|                            |           |                 |
|----------------------------|-----------|-----------------|
| // Client Side Connections |           |                 |
| Connections                |           |                 |
| Adapter,                   | Protocol, | Connection_Type |
| LonWorks,                  | LonWorks, | LonMaker        |

**4.4. Client Side Node Descriptors**

| Section Title |                                                                          |                                  |
|---------------|--------------------------------------------------------------------------|----------------------------------|
| Nodes         |                                                                          |                                  |
| Column Title  | Function                                                                 | Legal Values                     |
| Node_Name     | Provide name for node                                                    | Up to 32 alphanumeric characters |
| Subnet_ID     | Server (destination) node's Subnet ID of an explicitly addressed message | 1-255                            |
| Node_ID       | Server (destination) node's Node ID of an explicitly addressed message   | 1-127                            |
| Protocol      | Specify protocol used                                                    | LonWorks                         |
| Adapter       | Specify port Adapter used                                                | LonWorks                         |

**Example**

|                      |            |          |           |          |
|----------------------|------------|----------|-----------|----------|
| // Client Side Nodes |            |          |           |          |
| Nodes                |            |          |           |          |
| Node_Name,           | Subnet_ID, | Node_ID, | Protocol, | Adapter  |
| LON_1,               | 1,         | 1,       | LonWorks, | LonWorks |

## 4.5. Client Side Map Descriptors

### 4.5.1. FieldServer Related Map Descriptor Parameters

| Column Title        | Function                                                                         | Legal Values                                                |
|---------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------|
| Map_Descriptor_Name | Name of this Map Descriptor                                                      | Up to 16 alphanumeric characters. See Appendix A.19         |
| Data_Array_Name     | Name of Data Array where data is to be stored or fetched from in the FieldServer | One of the Data Array names from "Data Array" section above |
| Data_Array_Offset   | Starting location in Data Array                                                  | 0 to maximum specified in "Data Array" section above        |
| Lon_Function        | Detailed Function of Client Map Descriptor                                       | See Appendix A.1 for a list of valid entries.               |
| Function            | Function of Client Map Descriptor                                                | Filled-in according to Table in Appendix A.1                |

### 4.5.2. Driver Related Map Descriptor Parameters

| Column Title     | Function                                                                                                                                                      | Legal Values                                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Node_Name        | Name of Node to fetch data from or send data to. Needed for Explicit Addressing.                                                                              | One of the node names specified in "Client Node Descriptors" above |
| SNVT_Index       | Client or Server Network Variable Index depending on Implicit or Explicit Addressing.                                                                         | 0-4095 – See Appendix A.7                                          |
| SNVT_Type        | Standard network variable type of the data                                                                                                                    | See Appendix A.3                                                   |
| SNVT_Option      | Specifies which record out of a complex SNVT we are after.                                                                                                    | See Appendix A.20                                                  |
| SNVT_Units       | Specifies the measurement units (e.g. Metric or English)                                                                                                      | See Appendix A.21                                                  |
| UNVT_Byte_Length | Specifies the length in bytes of an UNVT.                                                                                                                     | 1-31. See Appendix A.4 to define an UNVT                           |
| UNVT_ID          | Specifies the Type Number to apply to this particular UNVT.                                                                                                   | 0 or 146-255. See Appendix A.4.                                    |
| NV_Min_Value     | Network Variable updates with values less than specified in this field will be ignored.                                                                       | See Appendix A.5                                                   |
| NV_Max_Value     | Network Variable updates with values higher than specified in this field will be ignored.                                                                     | See Appendix A.5                                                   |
| NV_Delta_Value   | Network Variable updates where the value's delta change is less than specified in this field will be ignored unless the Max_Scan_Time Condition has been met. | See Appendix A.6                                                   |
| NV_Selfdoc_Text  | The Self-Documenting String for this Network Variable.                                                                                                        | Normal Text up to a length of 40 characters                        |

**4.5.3. Timing Parameters**

| Column Title  | Function                      | Legal Values                |
|---------------|-------------------------------|-----------------------------|
| Scan_Interval | Seconds per scan              | 0-32000<br>See Appendix A.6 |
| Min_Scan_Time | Minimum Scan Time in seconds. | See Appendix A.6            |
| Max_Scan_Time | Maximum Scan Time in seconds. | See Appendix A.6            |

#### 4.6. Map Descriptor Example

// Client Side Map Descriptors

| Map_Descriptors      |                  |                    |               |           |            |             |              |                |               |               |               |
|----------------------|------------------|--------------------|---------------|-----------|------------|-------------|--------------|----------------|---------------|---------------|---------------|
| Map_Descriptor_Name, | Data_Array_Name, | Data_Array_Offset, | Lon_Function, | Function, | Node_Name, | SNVT_Index, | SNVT_Type,   | Nv_Delta_Value | Min_Scan_Time | Max_Scan_Time | Scan_Interval |
| TempOut1,            | DA_FO_01,        | 0,                 | NVUOIMT,      | WRBC,     | LON_1,     | 0,          | SNVT_Temp_f, | 10,            | 5,            | 20,           | -             |
| TempOut2,            | DA_FO_01,        | 1,                 | NVUOIMX,      | WRBX,     | LON_1,     | 1,          | SNVT_Temp_f, | -,             | -,            | -,            | -             |
| TempOut3,            | DA_FO_01,        | 2,                 | NVUOIMC,      | WRBC,     | LON_1,     | 1,          | SNVT_Temp_f, | -,             | -,            | -,            | 20            |
| TempIn,              | DA_FI_01,        | 0,                 | NVPIIMT,      | RDBC,     | LON_1,     | -,          | SNVT_Temp_f, | -,             | -,            | -,            | 5             |

This field determines the Map Descriptor's function. See Appendix A.1 for more information.

Explicitly Addressed Client Map Descriptors use this field to point to their relevant Server Map Descriptors. The driver will ignore this field and assign indexes to all Server and Implicitly Addressed Client Map Descriptors in the order they are declared in this file.

Required for Throttling Mode:  
This field specifies the minimum change needed for a Network Variable's value to invoke an NV Update.

The Data Array will be sampled and evaluated for delta change once every Min\_Scan\_Time (seconds)

If found during Min\_Scan\_Time sampling (Throttling Mode) that Max\_Scan\_Time has elapsed since the last NV Update, a new NV Update will be transmitted.

For Non-Throttled Client Map Descriptors the Scan\_Interval determines the update rate.



## 5. Configuring the FieldServer as a LonWorks Server

For a detailed discussion on FieldServer configuration, please refer to the FieldServer instruction manual. The information that follows describes how to expand upon the factory defaults provided in the configuration files included with the FieldServer (See “.csv” files on the driver CD).

This section documents and describes the parameters necessary for configuring the FieldServer to communicate with a LonWorks Driver Client.

### 5.1. Server Side Connection Descriptors

| Section Title   |                            |                                        |
|-----------------|----------------------------|----------------------------------------|
| Connections     |                            |                                        |
| Column Title    | Function                   | Legal Values                           |
| Adapter         | Adapter Name               | LonWorks                               |
| Protocol        | Specify protocol used      | LonWorks                               |
| Connection_Type | Specify Network Management | LonMaker®, LonWatcher, Circon_SI, None |

#### Example

```
// Server Side Connections
```

```
Connections
```

```
Adapter,
```

```
LonWorks,
```

```
Protocol,
```

```
LonWorks,
```

```
Connection_Type
```

```
LonMaker
```

### 5.2. Server Side Node Descriptors

| Section Title |                       |                                  |
|---------------|-----------------------|----------------------------------|
| Nodes         |                       |                                  |
| Column Title  | Function              | Legal Values                     |
| Node_Name     | Provide name for node | Up to 32 alphanumeric characters |
| Protocol      | Specify protocol used | LonWorks                         |

#### Example

```
// Server Side Nodes
```

```
Nodes
```

```
Node_Name,
```

```
LON_1,
```

```
Protocol
```

```
LonWorks
```

### 5.3. Server Side Map Descriptors

| Section Title       |                                                                                           |                                                             |
|---------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Map_Descriptors     |                                                                                           |                                                             |
| Column Title        | Function                                                                                  | Legal Values                                                |
| Map_Descriptor_Name | Name of this Map Descriptor                                                               | See Appendix A.2 and Appendix A.19                          |
| Data_Array_Name     | Name of Data Array where data is to be stored or fetched from in the FieldServer          | One of the Data Array names from "Data Array" section above |
| Data_Array_Offset   | Starting location in Data Array                                                           | 0 to maximum specified in "Data Array" section above        |
| Lon_Function        | Detailed Function of Server Map Descriptor                                                | See Appendix A.1 for a list of valid entries.               |
| Function            | Function of Server Map Descriptor                                                         | SERVER See Appendix A.1                                     |
| Node_Name           | Node Name specified above.                                                                | Up to 32 alphanumeric characters                            |
| SNVT_Index          | Index of data element.                                                                    | 0 - 4095<br>See Appendix A.7                                |
| SNVT_Type           | Standard or user-defined network variable type of the data                                | See Appendix A.3 and Appendix A.4 to define an UNVT         |
| SNVT_Option         | Specifies which record out of a complex SNVT we are after.                                | See Appendix A.20                                           |
| SNVT_Units          | Specifies the measurement units (e.g. Metric or English)                                  | See Appendix A.21                                           |
| UNVT_Byte_Length    | Specifies the length in bytes of an UNVT.                                                 | 1-31 See Appendix A.4 to define an UNVT                     |
| UNVT_ID             | Specifies the Type Number to apply to this particular UNVT.                               | 0 or 146-255. See Appendix A.4 to define an UNVT            |
| NV_Min_Value        | Network Variable updates with values less than specified in this field will be ignored.   | See Appendix A.5                                            |
| NV_Max_Value        | Network Variable updates with values higher than specified in this field will be ignored. | See Appendix A.5                                            |
| NV_Selfdoc_Text     | The Self-Documenting String for this Network Variable.                                    | Normal Text up to a length of 40 characters                 |

## 5.4. Map Descriptor Example

| // Server Side Map Descriptors |                  |                    |               |           |            |             |              |               |               |                 |
|--------------------------------|------------------|--------------------|---------------|-----------|------------|-------------|--------------|---------------|---------------|-----------------|
| Map_Descriptors                |                  |                    |               |           |            |             |              |               |               |                 |
| Map_Descriptor_Name,           | Data_Array_Name, | Data_Array_Offset, | Lon_Function, | Function, | Node_Name, | SNVT_Index, | SNVT_Type,   | Nv_Min_Value, | Nv_Max_Value, | Nv_Selfdoc_text |
| NviTemp,                       | DA_FI_01,        | 0,                 | NVUI,         | Server,   | LON_1,     | -,          | SNVT_Temp_f, | 0,            | -,            | "@01;WaterTemp" |
| NviTemp,                       | DA_FO_01,        | 1,                 | NVPO,         | Server,   | LON_1,     | -,          | SNVT_Temp_f, | 0,            | 150,          | "&2,0,0\x80,23" |
| NviTemp,                       | -,               | -,                 | CFG_NVUI,     | Server,   | LON_1,     | -,          | SNVT_Temp_f, | -,            | 150,          | "&2,0,0\x80,20" |

Server NVUI can be grouped with Client NV Update types and NMFETCHC. Server NVPO can be grouped with Client NV Poll types and NMFETCHC.

Explicitly Addressed Client Map Descriptors use this field to point to their relevant Server Map Descriptors. The driver will ignore this field and assign indexes to all Server and Implicitly Addressed Client Map Descriptors in the order they are declared in this file.

If specified for a Floating point or Integer SNVT then NV Updates with values lower than specified here will not be written to its relevant Data Array location.

If specified for a Floating point or Integer SNVT then NV Updates with values higher than specified here will not be written to its relevant Data Array location.

The Self-documenting String for a Network Variable can be up to 40 characters wide.



## Appendix A. Advanced Topics

### Appendix A.1. Lon\_Function Definitions

| Lon_Function | Description                                                                               | Function Field              |
|--------------|-------------------------------------------------------------------------------------------|-----------------------------|
| NVUI         | Network Variable Update Input                                                             | SERVER                      |
| NVPO         | Network Variable Polled Output                                                            |                             |
| NVPIEXC      | Network Variable Polled Input Explicitly addressed<br>Continuously sent                   | RDBC                        |
| NVPIIMC      | Network Variable Polled Input Implicitly addressed<br>Continuously sent                   |                             |
| NVUOEXC      | Network Variable Update Output Explicitly<br>addressed Continuously sent                  | WRBC                        |
| NVUOEXX      | Network Variable Update Output Explicitly<br>addressed and sent on Change                 | WRBX                        |
| NVUOEXT      | Network Variable Update Output Explicitly<br>addressed sent in Throttling Mode            | WRBC                        |
| NVUOIMC      | Network Variable Update Output Implicitly addressed<br>Continuously sent                  |                             |
| NVUOIMX      | Network Variable Update Output Implicitly addressed<br>and sent on Change                 | WRBX                        |
| NVUOIMT      | Network Variable Update Output Implicitly addressed<br>sent in Throttling Mode            | "WRBC" See<br>Appendix A.17 |
| NMFETCHC     | Network Management Network Variable Fetch<br>Continuously sent (Explicit Addressing only) | RDBC                        |
| CFG_NVUI     | Configuration Network Variable Update Input                                               | SERVER                      |

### Appendix A.2. Map Descriptor Names

As a Server, the LonWorks driver provides a table of network variables for other nodes to read. These nodes access the variables according to Index numbers which are automatically assigned by the driver according to the Map Descriptor definition order in the configuration file. The driver also creates an identification table for configuration nodes to read the name and types of variables available on the FieldServer. Within the LonWorks protocol, this table size is limited to 64K bytes. If you are intending to use a large number of Server mappings (up to 4096), you will need to limit the variable name length. Each Server mapping requires 4 bytes plus the length of the name from this 64K block.

### Appendix A.3. SNVT\_Type

The following section describes each SNVT as implemented on the FieldServer LonWorks driver.

**Data Length** – The number of Data Array elements required when specifying a Data Array name under a Map Descriptor.

**Suggested Data Array Formats** – This field suggests FieldServer Data Array formats in ascending order of storage space required while ensuring data integrity. It is not recommended to store a byte value in a bit Data Array since only the values 0 and 1 will be retained from the byte value resulting in a loss of resolution. If a byte value is stored in a Floating point Data Array, 3 bytes will go to waste. A SNVT with more than one data item may require a float Data Array format to prevent loss of resolution. Since FieldServer Map Descriptors can only work with one type of Data Array format for all the data items in a SNVT, we are sometimes forced to use a Float Data Array element for all data items of which some may only have required a Byte. Fortunately, all SNVT's are short in length and RAM is adequately provided for on the FieldServer. If a loss in resolution can be tolerated, any Data Array format may be used.

The range of FieldServer Data Arrays formats are:

| Data Array Format | Description             | Values Range                       |
|-------------------|-------------------------|------------------------------------|
| BIT               | 1-bit                   | 0,1                                |
| BYTE              | 8-bit Byte              | 0.. 255                            |
| SINT16            | 16-bit Signed Integer   | -32,768... 32,767                  |
| UINT16            | 16-bit Unsigned Integer | 0.. 65,535                         |
| SINT32            | 32-bit Signed Integer   | -2,147,483,647...<br>2,147,483,647 |
| UINT32            | 32-bit Unsigned Integer | 0.. 4,294,967,295                  |
| FLOAT             | 32-bit Float            | -3.40282E38... 3.40282E38          |

**Values Range** – These are the only values that will be allowed for the SNVT, e.g. a value of 101 will not be processed in a read or write on SNVT\_switch's Value data item.

**Invalid Value** – The Invalid value is used to force the data item's value should a value outside the value range be encountered in a read or write. Should the invalid value be N/A ( Not Applicable ), the data item's value will be bounded by the indicated values range, e.g. an incoming read value of 101 will be stored as 100 for SNVT\_switch's Value data item. Note that in some cases both the type and raw values are specified. Raw values are not of the same type of the SNVT's measurement type, i.e. they are not scaled.

**Data Item** – SNVT's containing more than one data item have a name specified for each item. This name can be used in the SNVT\_Option field of a Map Descriptor to isolate only this one item.

|                              |                                   |
|------------------------------|-----------------------------------|
| <b>SNVT_abs_humid</b>        |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Absolute humidity                 |
| Units                        | gram/kilogram                     |
| Values Range                 | 0.. 655.34                        |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 655.35 |
| <b>SNVT_address</b>          |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Uint16, Float                     |
| Data Item 1                  |                                   |
| Measurement                  | Neuron Chip Address               |
| Units                        | 16-bit address value              |
| Values Range                 | 16,384 .. 64,767                  |
| Invalid Value                | N/A                               |
| <b>SNVT_alarm</b>            |                                   |
| Data Length                  | 25                                |
| Suggested Data Array Formats | Uint16, Float                     |
| Data Item 1-6                | Alm_Location00, ..Alm_Location05  |
| Measurement                  | Location array element            |
| Units                        | 8-bit unsigned byte               |
| Values Range                 | 0 .. 255                          |
| Invalid Value                | N/A                               |
| Data Item 7                  | Object_ID                         |
| Measurement                  | Object ID                         |
| Units                        | object index                      |
| Values Range                 | 0 .. 65,535                       |
| Invalid Value                | N/A                               |
| Data Item 8                  | Alarm_type                        |
| Measurement                  | alarm_type_t                      |
| Units                        | N/A                               |
| Values Range                 | 0 .. 254                          |
| Invalid Value                | 255 (0xFF)(AL_NUL)                |
| Data Item 9                  | Priority_level                    |
| Measurement                  | Priority_level_t                  |
| Units                        | N/A                               |
| Values Range                 | 0 .. 11                           |
| Invalid Value                | 255 (0xFF)(PR_NUL)                |
| Data Item 10                 | Index_to_SNVT                     |
| Measurement                  | Index to NV                       |
| Units                        | index of NV causing alarm         |
| Values Range                 | 0 .. 65,535                       |
| Invalid Value                | N/A                               |
| Data Item 11-14              | Alm_Value00, ..Alm_Value03        |
| Measurement                  | Value array element               |
| Units                        | specific to NVT                   |
| Values Range                 | 0 .. 255                          |
| Invalid Value                | N/A                               |
| Data Item 15                 | Year                              |
| Measurement                  | Year                              |
| Units                        | year                              |
| Values Range                 | 0 .. 3000                         |

|                              |                              |
|------------------------------|------------------------------|
| Invalid Value                | N/A                          |
| Data Item 16                 | Month                        |
| Measurement                  | Month                        |
| Units                        | month of year                |
| Values Range                 | 0 ..12                       |
| Invalid Value                | N/A                          |
| Data Item 17                 | Day                          |
| Measurement                  | Day                          |
| Units                        | day of month                 |
| Values Range                 | 0 ..31                       |
| Invalid Value                | N/A                          |
| Data Item 18                 | Hour                         |
| Measurement                  | Hour                         |
| Units                        | Hour of day                  |
| Values Range                 | 0 ..23                       |
| Invalid Value                | N/A                          |
| Data Item 19                 | Minute                       |
| Measurement                  | Minute                       |
| Units                        | Minutes                      |
| Values Range                 | 0 ..59                       |
| Invalid Value                | N/A                          |
| Data Item 20                 | Second                       |
| Measurement                  | Second                       |
| Units                        | Seconds                      |
| Values Range                 | 0 ..59                       |
| Invalid Value                | N/A                          |
| Data Item 21                 | Millisecond                  |
| Measurement                  | Millisecond                  |
| Units                        | Milliseconds                 |
| Values Range                 | 0 ..999                      |
| Invalid Value                | N/A                          |
| Data Item 22-25              | Alm_limit00, ..Alm_limit03   |
| Measurement                  | Alarm limit array element    |
| Units                        | specific to NVT              |
| Values Range                 | 0 .. 255                     |
| Invalid Value                | N/A                          |
| <b>SNVT_amp</b>              |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Float                        |
| Data Item 1                  |                              |
| Measurement                  | Electric current             |
| Units                        | Amperes                      |
| Values Range                 | -3,276.8... 3,276.7          |
| Invalid Value                | N/A                          |
| <b>SNVT_amp_ac</b>           |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Uint16, Float                |
| Data Item 1                  |                              |
| Measurement                  | Alternating electric current |
| Units                        | Amperes                      |
| Values Range                 | 0 .. 65,534                  |
| Invalid Value                | 65,535 (0xFFFF)              |

|                              |                                   |
|------------------------------|-----------------------------------|
| <b>SNVT_amp_f</b>            |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Electric current                  |
| Units                        | Amperes                           |
| Values Range                 | -3.40282E38 .. 3.40282E38         |
| Invalid Value                | N/A                               |
| <b>SNVT_amp_mil</b>          |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Electric current                  |
| Units                        | Milli-amperes                     |
| Values Range                 | -3,276.8.. 3,276.7                |
| Invalid Value                | N/A                               |
| <b>SNVT_angle</b>            |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Uint16, Float                     |
| Data Item 1                  |                                   |
| Measurement                  | Phase/Rotation                    |
| Units                        | Radians                           |
| Values Range                 | 0 .. 65.535                       |
| Invalid Value                | N/A                               |
| <b>SNVT_angle_deg</b>        |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Angular distance                  |
| Units                        | degrees                           |
| Values Range                 | -359.98 .. 360.00                 |
| Invalid Value                | Type: 655.34 Raw: 32,767 (0x7FFF) |
| <b>SNVT_angle_f</b>          |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Phase/Rotation                    |
| Units                        | Radians                           |
| Values Range                 | -3.40282E38 .. 3.40282E38         |
| Invalid Value                | N/A                               |
| <b>SNVT_angle_vel</b>        |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Angular velocity                  |
| Units                        | Radians/second                    |
| Values Range                 | -3,276.8 .. 3,276.7               |
| Invalid Value                | N/A                               |

|                              |                                      |
|------------------------------|--------------------------------------|
| <b>SNVT_angle_vel_f</b>      |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Angular Velocity                     |
| Units                        | Radians/Second                       |
| Values Range                 | -3.40282E38 .. 3.40282E38            |
| Invalid Value                | N/A                                  |
| <b>SNVT_area</b>             |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Area                                 |
| Units                        | Square meters (m <sup>2</sup> )      |
| Values Range                 | 0 .. 13.1068                         |
| Invalid Value                | Type: 13.107    Raw: 0xFFFF (65,535) |
| <b>SNVT_btu_f</b>            |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Thermal Energy                       |
| Units                        | British Thermal Units                |
| Values Range                 | 0 .. 3.40282E38                      |
| Invalid Value                | N/A                                  |
| <b>SNVT_btu_kilo</b>         |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Uint16, Float                        |
| Data Item 1                  |                                      |
| Measurement                  | Thermal Energy                       |
| Units                        | Kilo-British Thermal Units           |
| Values Range                 | 0 .. 65,535                          |
| Invalid Value                | N/A                                  |
| <b>SNVT_btu_mega</b>         |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Uint16, Float                        |
| Data Item 1                  |                                      |
| Measurement                  | Thermal Energy                       |
| Units                        | Mega-British Thermal Units           |
| Values Range                 | 0 .. 65,535                          |
| Invalid Value                | N/A                                  |
| <b>SNVT_char_ascii</b>       |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Byte, Uint16, Float                  |
| Data Item 1                  |                                      |
| Measurement                  | Character                            |
| Units                        | 8-bit ASCII Character                |
| Values Range                 | 0 .. 255                             |
| Invalid Value                | N/A                                  |

|                              |                      |
|------------------------------|----------------------|
| <b>SNVT_chlr_status</b>      |                      |
| Data Length                  | 3                    |
| Suggested Data Array Formats | Byte, Uint16, Float  |
| Data Item 1                  | chlr_run_mode        |
| Measurement                  | chiller_t            |
| Units                        | N/A                  |
| Values Range                 | 0 .. 4               |
| Invalid Value                | 255 (0xFF)(CHLR_NUL) |
| Data Item 2                  | chlr_op_mode         |
| Measurement                  | hvac_t               |
| Units                        | N/A                  |
| Values Range                 | 0 .. 17              |
| Invalid Value                | 255 (0xFF)(HVAC_NUL) |
| Data Item 3                  | chlr_state           |
| Measurement                  |                      |
| Units                        | N/A                  |
| Values Range                 | 0 .. 255             |
| Invalid Value                | N/A                  |
| <b>SNVT_color</b>            |                      |
| Data Length                  | 3                    |
| Suggested Data Array Formats | Float                |
| Data Item 1                  | L_star               |
| Measurement                  | Lightness            |
| Units                        | Lightness            |
| Values Range                 | 0.0 .. 100.0         |
| Invalid Value                | N/A                  |
| Data Item 2                  | a_star               |
| Measurement                  | Redness/Greenness    |
| Units                        | Redness/Greenness    |
| Values Range                 | -200.0 .. 200.0      |
| Invalid Value                | N/A                  |
| Data Item 3                  | b_star               |
| Measurement                  | Yellowness/Blueness  |
| Units                        | Yellowness/Blueness  |
| Values Range                 | -200.0 .. 200.0      |
| Invalid Value                | N/A                  |
| <b>SNVT_config_src</b>       |                      |
| Data Length                  | 1                    |
| Suggested Data Array Formats | Byte, Uint16, Float  |
| Data Item 1                  |                      |
| Measurement                  | Config_source_t      |
| Units                        | N/A                  |
| Values Range                 | 0 .. 1               |
| Invalid Value                | 255 (0xFF)(CFG_NUL)  |
| <b>SNVT_count</b>            |                      |
| Data Length                  | 1                    |
| Suggested Data Array Formats | Uint16, Float        |
| Data Item 1                  |                      |
| Measurement                  | Event Count          |
| Units                        | Count                |
| Values Range                 | 0 .. 65,535          |
| Invalid Value                | N/A                  |

|                              |                           |
|------------------------------|---------------------------|
| <b>SNVT_count_f</b>          |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Event Count               |
| Units                        | Count                     |
| Values Range                 | 0 .. 3.40282E38           |
| Invalid Value                | N/A                       |
| <b>SNVT_count_inc</b>        |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Sint16, Float             |
| Data Item 1                  |                           |
| Measurement                  | Incremental Count         |
| Units                        | Count                     |
| Values Range                 | -32,768 .. 32,767         |
| Invalid Value                | N/A                       |
| <b>SNVT_count_inc_f</b>      |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Incremental Count         |
| Units                        | Count                     |
| Values Range                 | -3.40282E38 .. 3.40282E38 |
| Invalid Value                | N/A                       |
| <b>SNVT_ctrl_req</b>         |                           |
| Data Length                  | 3                         |
| Suggested Data Array Formats | Uint16, Float             |
| Data Item 1                  | ctl_req_rcvr_id           |
| Measurement                  | Receiver ID               |
| Units                        | ID number                 |
| Values Range                 | 1 .. 65,535               |
| Invalid Value                | 0                         |
| Data Item 2                  | ctl_req_sndr_id           |
| Measurement                  | Sender ID                 |
| Units                        | ID number                 |
| Values Range                 | 1 .. 65,534               |
| Invalid Value                | 65,535 (0xFFFF)           |
| Data Item 3                  | ctl_req_sndr_pri          |
| Measurement                  | Sender priority           |
| Units                        | Priority value            |
| Values Range                 | 0 .. 200                  |
| Invalid Value                | N/A                       |

|                              |                                 |
|------------------------------|---------------------------------|
| <b>SNVT_ctrl_resp</b>        |                                 |
| Data Length                  | 5                               |
| Suggested Data Array Formats | Uint16, Float                   |
| Data Item 1                  | ctl_rsp_status                  |
| Measurement                  | control_resp_t                  |
| Units                        | N/A                             |
| Values Range                 | 0 .. 5                          |
| Invalid Value                | 255 (0xFF)(CTRLR_NUL)           |
| Data Item 2                  | ctl_rsp_snd_id                  |
| Measurement                  | Sender ID                       |
| Units                        | ID number                       |
| Values Range                 | 1 .. 65,534                     |
| Invalid Value                | 65,535 (0xFFFF)                 |
| Data Item 3                  | ctl_rsp_snd_rlower              |
| Measurement                  | Sender Range Lower ID           |
| Units                        | ID number                       |
| Values Range                 | 1 .. 65,534                     |
| Invalid Value                | 65,535 (0xFFFF)                 |
| Data Item 4                  | ctl_rsp_snd_rupper              |
| Measurement                  | Sender Range Upper ID           |
| Units                        | ID number                       |
| Values Range                 | 1 .. 65,534                     |
| Invalid Value                | 65,535 (0xFFFF)                 |
| Data Item 5                  | ctl_rsp_cntrl_id                |
| Measurement                  | Controller ID                   |
| Units                        | ID number                       |
| Values Range                 | 1 .. 65,534                     |
| Invalid Value                | 65,535 (0xFFFF)                 |
| <b>SNVT_currency</b>         |                                 |
| Data Length                  | 3                               |
| Suggested Data Array Formats | Sint32                          |
| Data Item 1                  | Currency                        |
| Measurement                  | Currency_t                      |
| Units                        | N/A                             |
| Values Range                 | 0 .. 56                         |
| Invalid Value                | 255 (0xFF)(CU_NUL)              |
| Data Item 2                  | Power_of_10                     |
| Measurement                  | Magnitude                       |
| Units                        | Power of 10                     |
| Values Range                 | -128 .. 127                     |
| Invalid Value                | N/A                             |
| Data Item 3                  | Currency_Value                  |
| Measurement                  | Value                           |
| Units                        | Currency Value                  |
| Values Range                 | -2,147,483,648 .. 2,147,483,647 |
| Invalid Value                | N/A                             |

|                              |                                                |
|------------------------------|------------------------------------------------|
| <b>SNVT_date_day</b>         |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Byte, Uint16, Float                            |
| Data Item 1                  |                                                |
| Measurement                  | days_of_week_t                                 |
| Units                        | N/A                                            |
| Values Range                 | 0 .. 6                                         |
| Invalid Value                | 255 (0xFF)                                     |
| <b>SNVT_defr_mode</b>        |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Byte, Uint16, Float                            |
| Data Item 1                  |                                                |
| Measurement                  | defrost_t                                      |
| Units                        | N/A                                            |
| Values Range                 | 0 .. 2                                         |
| Invalid Value                | 255 (0xFF)(DFM_MODE_NUL)                       |
| <b>SNVT_defr_state</b>       |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Byte, Uint16, Float                            |
| Data Item 1                  |                                                |
| Measurement                  | defrost_state_t                                |
| Units                        | N/A                                            |
| Values Range                 | 0 .. 4                                         |
| Invalid Value                | 255 (0xFF)(DFS_NUL)                            |
| <b>SNVT_defr_term</b>        |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Byte, Uint16, Float                            |
| Data Item 1                  |                                                |
| Measurement                  | defrost_term_t                                 |
| Units                        | N/A                                            |
| Values Range                 | 0 .. 100                                       |
| Invalid Value                | 255 (0xFF)(DFT_NUL)                            |
| <b>SNVT_density</b>          |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Float                                          |
| Data Item 1                  |                                                |
| Measurement                  | Density                                        |
| Units                        | Kg/m <sup>3</sup> : kilograms per cubic meter  |
| Values Range                 | 0 .. 32,767.5                                  |
| Invalid Value                | N/A                                            |
| <b>SNVT_density_f</b>        |                                                |
| Data Length                  | 1                                              |
| Suggested Data Array Formats | Float                                          |
| Data Item 1                  |                                                |
| Measurement                  | Density                                        |
| Units                        | Kilograms per Cubic Meter (kg/m <sup>3</sup> ) |
| Values Range                 | 0 .. 3.40282E38                                |
| Invalid Value                | N/A                                            |

|                              |                                   |
|------------------------------|-----------------------------------|
| <b>SNVT_dev_c_mode</b>       |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Byte, Uint16, Float               |
| Data Item 1                  |                                   |
| Measurement                  | device_c_mode_t                   |
| Units                        | N/A                               |
| Values Range                 | 0 .. 29                           |
| Invalid Value                | 255 (0xFF)(DCM_NUL)               |
| <b>SNVT_earth_pos</b>        |                                   |
| Data Length                  | 6                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  | epos_dir_bits                     |
| Measurement                  | Latitude/Longitude                |
| Units                        | Direction                         |
| Values Range                 | 0 .. 255                          |
| Invalid Value                | N/A                               |
| Data Item 2                  | epos_lat_degs                     |
| Measurement                  | Latitude degrees                  |
| Units                        | Degrees                           |
| Values Range                 | 1 .. 90                           |
| Invalid Value                | 255 (0xFF)                        |
| Data Item 3                  | epos_lat_mins                     |
| Measurement                  | Latitude Minutes                  |
| Units                        | Minutes                           |
| Values Range                 | 1 .. 59.999                       |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 65.535 |
| Data Item 4                  | epos_long_degs                    |
| Measurement                  | Longitude Degrees                 |
| Units                        | Degrees                           |
| Values Range                 | 1 ..180                           |
| Invalid Value                | 255 (0xFF)                        |
| Data Item 5                  | epos_long_mins                    |
| Measurement                  | Longitude Minutes                 |
| Units                        | Minutes                           |
| Values Range                 | 1 .. 59.999                       |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 65.535 |
| Data Item 6                  | epos_htabv_sea                    |
| Measurement                  | Height Above Sea Level            |
| Units                        | Meters (m)                        |
| Values Range                 | -3.40282E38 .. 3.40282E38         |
| Invalid Value                | N/A                               |

|                              |                                 |
|------------------------------|---------------------------------|
| <b>SNVT_elapsed_tm</b>       |                                 |
| Data Length                  | 5                               |
| Suggested Data Array Formats | Uint16, Float                   |
| Data Item 1                  | etm_day                         |
| Measurement                  | Days                            |
| Units                        | Days                            |
| Values Range                 | 0 .. 65,534                     |
| Invalid Value                | 65,535 (0xFFFF)                 |
| Data Item 2                  | etm_hour                        |
| Measurement                  | Hours                           |
| Units                        | Hours                           |
| Values Range                 | 0 .. 23                         |
| Invalid Value                | N/A                             |
| Data Item 3                  | etm_minute                      |
| Measurement                  | Minutes                         |
| Units                        | Minutes                         |
| Values Range                 | 0 .. 59                         |
| Invalid Value                | N/A                             |
| Data Item 4                  | etm_second                      |
| Measurement                  | Seconds                         |
| Units                        | Seconds                         |
| Values Range                 | 0 .. 59                         |
| Invalid Value                | N/A                             |
| Data Item 5                  | etm_millisecond                 |
| Measurement                  | Milliseconds                    |
| Units                        | Milliseconds                    |
| Values Range                 | 0 .. 999                        |
| Invalid Value                | N/A                             |
| <b>SNVT_elec_kwh</b>         |                                 |
| Data Length                  | 1                               |
| Suggested Data Array Formats | Uint16, Float                   |
| Data Item 1                  |                                 |
| Measurement                  | Electrical energy               |
| Units                        | Kilowatt-hours                  |
| Values Range                 | 0 .. 65,535                     |
| Invalid Value                | N/A                             |
| <b>SNVT_elec_kwh_I</b>       |                                 |
| Data Length                  | 1                               |
| Suggested Data Array Formats | Sint32                          |
| Data Item 1                  |                                 |
| Measurement                  | Electricity                     |
| Units                        | Kilowatt-hour                   |
| Values Range                 | -214,748,364.8 .. 214,748,364.6 |
| Invalid Value                | -214,748,364.7 (0x7FFFFFFF)     |
| <b>SNVT_elec_whr</b>         |                                 |
| Data Length                  | 1                               |
| Suggested Data Array Formats | Float                           |
| Data Item 1                  |                                 |
| Measurement                  | Electric energy                 |
| Units                        | Watt-hours                      |
| Values Range                 | 0 .. 6,553.5                    |
| Invalid Value                | N/A                             |

|                              |                                    |
|------------------------------|------------------------------------|
| <b>SNVT_elec_whr_f</b>       |                                    |
| Data Length                  | 1                                  |
| Suggested Data Array Formats | Float                              |
| Data Item 1                  |                                    |
| Measurement                  | Electric Energy                    |
| Units                        | Watt-hour                          |
| Values Range                 | 0 .. 3.40282E38                    |
| Invalid Value                | N/A                                |
| <b>SNVT_enthalpy</b>         |                                    |
| Data Length                  | 1                                  |
| Suggested Data Array Formats | Float                              |
| Data Item 1                  |                                    |
| Measurement                  | Enthalpy                           |
| Units                        | KiloJoules per Kilogram kJ/kg      |
| Values Range                 | -327.68 .. 327.66                  |
| Invalid Value                | Raw: 32,767 (0x7FFF) Type: 327.67  |
| <b>SNVT_evap_state</b>       |                                    |
| Data Length                  | 1                                  |
| Suggested Data Array Formats | Byte, Uint16, Float                |
| Data Item 1                  |                                    |
| Measurement                  | evap_t                             |
| Units                        | N/A                                |
| Values Range                 | 0 .. 2                             |
| Invalid Value                | 255 (0xFF)(EVAP_NUL)               |
| <b>SNVT_ex_control</b>       |                                    |
| Data Length                  | 10                                 |
| Suggested Data Array Formats | Byte, Uint16, Float                |
| Data Item 1                  | ex_ctrl_status                     |
| Measurement                  | ex_control_t                       |
| Units                        | N/A                                |
| Values Range                 | 0 .. 2                             |
| Invalid Value                | 255 (0xFF)(EX_CONTROL_NUL)         |
| Data Item 2-7                | ex_ctrl_domid_0, ..ex_ctrl_domid_5 |
| Measurement                  | Domain ID                          |
| Units                        | Byte                               |
| Values Range                 | 0 .. 255                           |
| Invalid Value                | N/A                                |
| Data Item 8                  | ex_ctrl_domid_len                  |
| Measurement                  | Domain length                      |
| Units                        | Number of bytes                    |
| Values Range                 | 0 .. 6                             |
| Invalid Value                | N/A                                |
| Data Item 9                  | ex_ctrl_subnet                     |
| Measurement                  | Subnet                             |
| Units                        | Subnet number                      |
| Values Range                 | 1 .. 255                           |
| Invalid Value                | N/A                                |
| Data Item 10                 | ex_ctrl_node                       |
| Measurement                  | Node                               |
| Units                        | Node number                        |
| Values Range                 | 1 .. 127                           |
| Invalid Value                | N/A                                |

|                                                   |                           |
|---------------------------------------------------|---------------------------|
| <b>SNVT_file_pos</b>                              |                           |
| Data Length                                       | 2                         |
| Suggested Data Array Formats                      | Uint32                    |
| Data Item 1                                       | ops_rw_ptr                |
| Measurement                                       | Read/Write Pointer        |
| Units                                             | File Byte Address         |
| Values Range                                      | 0 .. 2,147,483,647        |
| Invalid Value                                     | N/A                       |
| Data Item 2                                       | ops_rw_len                |
| Measurement                                       | Read/Write Length         |
| Units                                             | Number of Bytes           |
| Values Range                                      | 0 .. 65,535               |
| Invalid Value                                     | N/A                       |
| <b>SNVT_file_req (only raw data supported)</b>    |                           |
| Data Length                                       | 12                        |
| Suggested Data Array Formats                      | Byte                      |
| <b>SNVT_file_status (only raw data supported)</b> |                           |
| Data Length                                       | 27                        |
| Suggested Data Array Formats                      | Byte                      |
| <b>SNVT_fire_test</b>                             |                           |
| Data Length                                       | 1                         |
| Suggested Data Array Formats                      | Byte, Uint16, Float       |
| Data Item 1                                       |                           |
| Measurement                                       | fire_test_t               |
| Units                                             | N/A                       |
| Values Range                                      | 0 .. 3                    |
| Invalid Value                                     | 255 (0xFF)(FT_NUL)        |
| <b>SNVT_flow</b>                                  |                           |
| Data Length                                       | 1                         |
| Suggested Data Array Formats                      | Uint16, Float             |
| Data Item 1                                       |                           |
| Measurement                                       | Flow volume               |
| Units                                             | Liters/Second             |
| Values Range                                      | 0 .. 65,534               |
| Invalid Value                                     | 65,535 (0xFFFF)           |
| <b>SNVT_flow_f</b>                                |                           |
| Data Length                                       | 1                         |
| Suggested Data Array Formats                      | Float                     |
| Data Item 1                                       |                           |
| Measurement                                       | Flow Volume               |
| Units                                             | Liters/Second             |
| Values Range                                      | -3.40282E38 .. 3.40282E38 |
| Invalid Value                                     | N/A                       |
| <b>SNVT_flow_mil</b>                              |                           |
| Data Length                                       | 1                         |
| Suggested Data Array Formats                      | Uint16, Float             |
| Data Item 1                                       |                           |
| Measurement                                       | Flow volume               |
| Units                                             | Milliliters/Second (ml/s) |
| Values Range                                      | 0 .. 65,535               |
| Invalid Value                                     | N/A                       |

|                              |                                   |
|------------------------------|-----------------------------------|
| <b>SNVT_flow_p</b>           |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Flow volume                       |
| Units                        | Cubic metres per hour             |
| Values Range                 | 0 .. 655.34                       |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 655.35 |
| <b>SNVT_freq_f</b>           |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Frequency                         |
| Units                        | Hertz                             |
| Values Range                 | 0 .. 3.40282E38                   |
| Invalid Value                | N/A                               |
| <b>SNVT_freq_hz</b>          |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Frequency                         |
| Units                        | Hertz                             |
| Values Range                 | 0 .. 6,553.5                      |
| Invalid Value                | N/A                               |
| <b>SNVT_freq_kilohz</b>      |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Frequency                         |
| Units                        | Kilohertz                         |
| Values Range                 | 0 .. 6,553.5                      |
| Invalid Value                | N/A                               |
| <b>SNVT_freq_milhz</b>       |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Frequency                         |
| Units                        | Hertz                             |
| Values Range                 | 0 .. 6.5535                       |
| Invalid Value                | N/A                               |
| <b>SNVT_fire_init</b>        |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Byte, Uint16, Float               |
| Data Item 1                  |                                   |
| Measurement                  | fire_initiator_t                  |
| Units                        | N/A                               |
| Values Range                 | 0 .. 16                           |
| Invalid Value                | 255 (0xFF)(FI_NUL)                |

|                              |                       |
|------------------------------|-----------------------|
| <b>SNVT_fire_indcte</b>      |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | fire_indicator_t      |
| Units                        | N/A                   |
| Values Range                 | 0 .. 8                |
| Invalid Value                | 255 (0xFF)(FN_NUL)    |
| <b>SNVT_gfci_status</b>      |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | gfci_status_t         |
| Units                        | N/A                   |
| Values Range                 | 0 .. 5                |
| Invalid Value                | 255 (0xFF)(GFCI_NUL)  |
| <b>SNVT_grammage</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Grammage              |
| Units                        | Grams/Square-meter    |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_grammage_f</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Grammage              |
| Units                        | Grams/Square-meter    |
| Values Range                 | 0 .. 3.40282E38       |
| Invalid Value                | N/A                   |
| <b>SNVT_hvac_emerg</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | emerg_t               |
| Units                        | N/A                   |
| Values Range                 | 0 .. 5                |
| Invalid Value                | 255 (0xFF)(EMERG_NUL) |
| <b>SNVT_hvac_mode</b>        |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | Hvac_t                |
| Units                        | N/A                   |
| Values Range                 | 0 .. 17               |
| Invalid Value                | 255 (0xFF)(HVAC_NUL)  |

| SNVT_hvac_overid             |                                    |
|------------------------------|------------------------------------|
| Data Length                  | 3                                  |
| Suggested Data Array Formats | Float                              |
| Data Item 1                  | hvac_ord_state                     |
| Measurement                  | hvac_overid_t                      |
| Units                        | N/A                                |
| Values Range                 | 0 .. 48                            |
| Invalid Value                | 255 (0xFF)(HVO_NUL)                |
| Data Item 2                  | hvac_ord_percent                   |
| Measurement                  | Percent                            |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 3                  | hvac_ord_flow                      |
| Measurement                  | Flow                               |
| Units                        | Liters per Second                  |
| Values Range                 | 0 .. 65,534                        |
| Invalid Value                | 65,535 (0xFFF)                     |

|                              |                                    |
|------------------------------|------------------------------------|
| <b>SNVT_hvac_status</b>      |                                    |
| Data Length                  | 7                                  |
| Suggested Data Array Formats | Float                              |
| Data Item 1                  | hvac_sts_mode                      |
| Measurement                  | hvac_t                             |
| Units                        | N/A                                |
| Values Range                 | 0 .. 17                            |
| Invalid Value                | 255 (0xFF)(HV_NUL)                 |
| Data Item 2                  | hvac_heat_out_pri                  |
| Measurement                  | Primary Heat Output                |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 3                  | hvac_heat_out_sec                  |
| Measurement                  | Secondary Heat Output              |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 4                  | hvac_cool_out                      |
| Measurement                  | Cooling Output                     |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 5                  | hvac_econ_out                      |
| Measurement                  | Economizer Output                  |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 6                  | hvac_fan_out                       |
| Measurement                  | Fan Output                         |
| Units                        | Percent of Full Scale              |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Type: 163.835 Raw: 32,767 (0x7FFF) |
| Data Item 7                  | hvac_in_alarm                      |
| Measurement                  | In Alarm State                     |
| Units                        | Alarm value                        |
| Values Range                 | 0 .. 1                             |
| Invalid Value                | N/A                                |
| <b>SNVT_hvac_type</b>        |                                    |
| Data Length                  | 1                                  |
| Suggested Data Array Formats | Byte, Uint16, Float                |
| Data Item 1                  |                                    |
| Measurement                  | Hvac_hvt_t                         |
| Units                        | N/A                                |
| Values Range                 | 0 .. 9                             |
| Invalid Value                | 255 (0xFF)(HVT_NUL)                |

|                              |                       |
|------------------------------|-----------------------|
| <b>SNVT_length</b>           |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Length                |
| Units                        | Meters (m)            |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_length_f</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Length                |
| Units                        | Meters                |
| Values Range                 | 0 .. 3.40282E38       |
| Invalid Value                | N/A                   |
| <b>SNVT_length_kilo</b>      |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Length                |
| Units                        | Kilometers (km)       |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_length_micr</b>      |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Length                |
| Units                        | Micrometers, Microns  |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_length_mil</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Length                |
| Units                        | Millimeters (mm)      |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_lev_cont</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Continuous Level      |
| Units                        | Percent of Full Level |
| Values Range                 | 0 .. 100.0            |
| Invalid Value                | N/A                   |

|                                               |                                                   |
|-----------------------------------------------|---------------------------------------------------|
| <b>SNVT_lev_cont_f</b>                        |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Float                                             |
| Data Item 1                                   |                                                   |
| Measurement                                   | Continuous Level                                  |
| Units                                         | Percent of Full Scale                             |
| Values Range                                  | 0 .. 100                                          |
| Invalid Value                                 | N/A                                               |
| <b>SNVT_lev_disc</b>                          |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Byte, Uint16, Float                               |
| Data Item 1                                   |                                                   |
| Measurement                                   | Discrete_levels_t                                 |
| Units                                         | N/A                                               |
| Values Range                                  | 0 .. 4                                            |
| Invalid Value                                 | 255 (0xFF)(ST_NUL)                                |
| <b>SNVT_lev_percent</b>                       |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Float                                             |
| Data Item 1                                   |                                                   |
| Measurement                                   | Percentage Level                                  |
| Units                                         | Percent of Full Scale, or Parts-per Million (ppm) |
| Values Range                                  | -163.840 .. 163.830                               |
| Invalid Value                                 | Type: 163.835    Raw: 32,767 (0x7FFF)             |
| <b>SNVT_lux</b>                               |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Uint16, Float                                     |
| Data Item 1                                   |                                                   |
| Measurement                                   | Illumination                                      |
| Units                                         | Lux                                               |
| Values Range                                  | 0 .. 65,535                                       |
| Invalid Value                                 | N/A                                               |
| <b>SNVT_magcard (only raw data supported)</b> |                                                   |
| Data Length                                   | 20                                                |
| Suggested Data Array Formats                  | Byte                                              |
| <b>SNVT_mass</b>                              |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Float                                             |
| Data Item 1                                   |                                                   |
| Measurement                                   | Mass                                              |
| Units                                         | Grams                                             |
| Values Range                                  | 0 .. 6,553.5                                      |
| Invalid Value                                 | N/A                                               |
| <b>SNVT_mass_f</b>                            |                                                   |
| Data Length                                   | 1                                                 |
| Suggested Data Array Formats                  | Float                                             |
| Data Item 1                                   |                                                   |
| Measurement                                   | Mass                                              |
| Units                                         | Grams                                             |
| Values Range                                  | 0 .. 3.40282E38                                   |
| Invalid Value                                 | N/A                                               |

|                              |                       |
|------------------------------|-----------------------|
| <b>SNVT_mass_kilo</b>        |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Mass                  |
| Units                        | Kilograms (kg)        |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_mass_mega</b>        |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Mass                  |
| Units                        | Metric Tons; Tonne    |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_mass_mil</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Mass                  |
| Units                        | Milligrams (mg)       |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_motor_state</b>      |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | motor_state_t         |
| Units                        | N/A                   |
| Values Range                 | 0 .. 7                |
| Invalid Value                | 255 (0xFF)(MOTOR_NUL) |
| <b>SNVT_muldiv</b>           |                       |
| Data Length                  | 2                     |
| Suggested Data Array Formats | Uint16, Float         |
| Data Item 1                  | Multiplier            |
| Measurement                  | Multiplier            |
| Units                        | N/A                   |
| Values Range                 | 0 .. 65,535           |
| Invalid Value                | N/A                   |
| Data Item 2                  | Divisor               |
| Measurement                  | Divisor               |
| Units                        | N/A                   |
| Values Range                 | 1 .. 65,535           |
| Invalid Value                | 0                     |
| <b>SNVT_multiplier</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Multiplier            |
| Units                        | N/A                   |
| Values Range                 | 0 .. 32.7675          |
| Invalid Value                | N/A                   |

| SNVT_nv_type                 |                              |
|------------------------------|------------------------------|
| Data Length                  | 15                           |
| Suggested Data Array Formats | Byte, Uint16, Float          |
| Data Item 1-8                | nv_type_pid0, ..nv_type_pid7 |
| Measurement                  | Program ID                   |
| Units                        | N/A                          |
| Values Range                 | 0 .. 255                     |
| Invalid Value                | N/A                          |
| Data Item 9                  | nv_type_scope                |
| Measurement                  | Scope                        |
| Units                        | N/A                          |
| Values Range                 | 0 .. 6                       |
| Invalid Value                | N/A                          |
| Data Item 10                 | nv_type_index                |
| Measurement                  | Type index                   |
| Units                        | N/A                          |
| Values Range                 | 1 .. 65,535                  |
| Invalid Value                | 0                            |
| Data Item 11                 | nv_type_cat                  |
| Measurement                  | nv_type_category_t           |
| Units                        | N/A                          |
| Values Range                 | 1 .. 14                      |
| Invalid Value                | 255 (0xFF)(NVT_CAT_NUL)      |
| Data Item 12                 | nv_type_length               |
| Measurement                  | Type length                  |
| Units                        | Bytes                        |
| Values Range                 | 1 .. 31                      |
| Invalid Value                | 0                            |
| Data Item 13                 | nv_type_scale_a              |
| Measurement                  | Scaling multiplier           |
| Units                        | N/A                          |
| Values Range                 | -32,768 .. 32,766            |
| Invalid Value                | 32,767                       |
| Data Item 14                 | nv_type_scale_b              |
| Measurement                  | Scaling exponent             |
| Units                        | N/A                          |
| Values Range                 | -32,768 .. 32,766            |
| Invalid Value                | 32,767                       |
| Data Item 15                 | nv_type_scale_c              |
| Measurement                  | Scaling offset               |
| Units                        | N/A                          |
| Values Range                 | -32,768 .. 32,766            |
| Invalid Value                | 32,767                       |

|                              |                     |
|------------------------------|---------------------|
| <b>SNVT_obj_request</b>      |                     |
| Data Length                  | 2                   |
| Suggested Data Array Formats | Uint16, Float       |
| Data Item 1                  | obj_request_id      |
| Measurement                  | Object ID           |
| Units                        | object index        |
| Values Range                 | 0 .. 65,535         |
| Invalid Value                | N/A                 |
| Data Item 2                  | obj_request         |
| Measurement                  | object_request_t    |
| Units                        | N/A                 |
| Values Range                 | 0 .. 17             |
| Invalid Value                | 255 (0xFF)(RQ_NUL)  |
| <b>SNVT_obj_status</b>       |                     |
| Data Length                  | 2                   |
| Suggested Data Array Formats | Uint32              |
| Data Item 1                  | obj_status_id       |
| Measurement                  | Functional Block ID |
| Units                        | N/A                 |
| Values Range                 | 0 .. 65,535         |
| Invalid Value                | N/A                 |
| Data Item 2                  | obj_status_bits     |
| Measurement                  | object_status_bits  |
| Units                        | Bits                |
| Values Range                 | 0 .. 4,294,967,295  |
| Invalid Value                | N/A                 |
| <b>SNVT_occupancy</b>        |                     |
| Data Length                  | 1                   |
| Suggested Data Array Formats | Byte, Uint16, Float |
| Data Item 1                  |                     |
| Measurement                  | Occup_t             |
| Units                        | N/A                 |
| Values Range                 | 0 .. 3              |
| Invalid Value                | 255 (0xFF)(OC_NUL)  |
| <b>SNVT_override</b>         |                     |
| Data Length                  | 1                   |
| Suggested Data Array Formats | Byte, Uint16, Float |
| Data Item 1                  |                     |
| Measurement                  | override_t          |
| Units                        | N/A                 |
| Values Range                 | 0 .. 2              |
| Invalid Value                | 255 (0xFF)(OV_NUL)  |
| <b>SNVT_ph</b>               |                     |
| Data Length                  | 1                   |
| Suggested Data Array Formats | Float               |
| Data Item 1                  |                     |
| Measurement                  | Acidity             |
| Units                        | pH                  |
| Values Range                 | -32.768 .. 32.767   |
| Invalid Value                | N/A                 |

| SNVT_ph_f                    |                           |
|------------------------------|---------------------------|
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Acidity                   |
| Units                        | pH                        |
| Values Range                 | -3.40282E38 .. 3.40282E38 |
| Invalid Value                | N/A                       |

| SNVT_pos_ctrl                |                                    |
|------------------------------|------------------------------------|
| Data Length                  | 9                                  |
| Suggested Data Array Formats | Float                              |
| Data Item 1                  | pos_ctrl_rcvr_id                   |
| Measurement                  | Receiver ID                        |
| Units                        | ID number                          |
| Values Range                 | 1 .. 65,535                        |
| Invalid Value                | 0                                  |
| Data Item 2                  | pos_ctrl_cntrl_id                  |
| Measurement                  | Controller ID                      |
| Units                        | ID number                          |
| Values Range                 | 1 .. 65,534                        |
| Invalid Value                | 65,535 (0xFFFF)                    |
| Data Item 3                  | pos_ctrl_cntrl_prio                |
| Measurement                  | Controller priority                |
| Units                        | Priority value                     |
| Values Range                 | 0 .. 200                           |
| Invalid Value                | N/A                                |
| Data Item 4                  | pos_ctrl_function                  |
| Measurement                  | cam_func_t                         |
| Units                        | N/A                                |
| Values Range                 | 0 .. 2                             |
| Invalid Value                | 255 (0xFF)(CMF_NUL)                |
| Data Item 5                  | pos_ctrl_action                    |
| Measurement                  | cam_act_t                          |
| Units                        | N/A                                |
| Values Range                 | 0 .. 2                             |
| Invalid Value                | 255 (0xFF)(CMA_NUL)                |
| Data Item 6                  | pos_ctrl_number                    |
| Measurement                  | Action number                      |
| Units                        | Action number                      |
| Values Range                 | 1 .. 255                           |
| Invalid Value                | 0                                  |
| Data Item 7                  | pos_ctrl_pan                       |
| Measurement                  | Pan position                       |
| Units                        | Degrees                            |
| Values Range                 | -359.98 .. 360.00                  |
| Invalid Value                | Raw: 32,767 (0x7FFF) Type: 655.34  |
| Data Item 8                  | pos_ctrl_tilt                      |
| Measurement                  | Tilt position                      |
| Units                        | Degrees                            |
| Values Range                 | -359.98 .. 360.00                  |
| Invalid Value                | Raw: 32,767 (0x7FFF) Type: 655.34  |
| Data Item 9                  | pos_ctrl_zoom                      |
| Measurement                  | Zoom position                      |
| Units                        | Percent of full-scale or ppm       |
| Values Range                 | -163.840 .. 163.830                |
| Invalid Value                | Raw: 32,767 (0x7FFF) Type: 163.835 |

|                              |                           |
|------------------------------|---------------------------|
| <b>SNVT_power</b>            |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Power                     |
| Units                        | Watts (W)                 |
| Values Range                 | 0 .. 6,553.5              |
| Invalid Value                | N/A                       |
| <b>SNVT_power_f</b>          |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Power                     |
| Units                        | Watts                     |
| Values Range                 | -3.40282E38 .. 3.40282E38 |
| Invalid Value                | N/A                       |
| <b>SNVT_power_kilo</b>       |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Power                     |
| Units                        | KiloWatts                 |
| Values Range                 | 0 .. 6,553.5              |
| Invalid Value                | N/A                       |
| <b>SNVT_ppm</b>              |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Uint16, Float             |
| Data Item 1                  |                           |
| Measurement                  | Concentration             |
| Units                        | Parts per Million (ppm)   |
| Values Range                 | 0 .. 65,535               |
| Invalid Value                | N/A                       |
| <b>SNVT_ppm_f</b>            |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Concentration             |
| Units                        | Parts per Million         |
| Values Range                 | 0 .. 3.40282E38           |
| Invalid Value                | N/A                       |

|                              |                                       |
|------------------------------|---------------------------------------|
| <b>SNVT_preset</b>           |                                       |
| Data Length                  | 11                                    |
| Suggested Data Array Formats | Uint16, Float                         |
| Data Item 1                  | preset_learn                          |
| Measurement                  | learn_mode_t                          |
| Units                        | N/A                                   |
| Values Range                 | 0 .. 3                                |
| Invalid Value                | 255 (0xFF)(LN_NUL)                    |
| Data Item 2                  | preset_selector                       |
| Measurement                  | Selector                              |
| Units                        | N/A                                   |
| Values Range                 | 0 .. 65,535                           |
| Invalid Value                | N/A                                   |
| Data Item 3-6                | preset_value00, ..preset_value03      |
| Measurement                  | Value                                 |
| Units                        | Specific to SNVT                      |
| Values Range                 | 0 .. 255                              |
| Invalid Value                | N/A                                   |
| Data Item 7                  | preset_day                            |
| Measurement                  | Days                                  |
| Units                        | Days                                  |
| Values Range                 | 0 .. 65,534                           |
| Invalid Value                | 65,535 (0xFFFF)                       |
| Data Item 8                  | preset_hour                           |
| Measurement                  | Hours                                 |
| Units                        | Hour                                  |
| Values Range                 | 0 .. 23                               |
| Invalid Value                | N/A                                   |
| Data Item 9                  | preset_minute                         |
| Measurement                  | Minutes                               |
| Units                        | Minutes                               |
| Values Range                 | 0 .. 59                               |
| Invalid Value                | N/A                                   |
| Data Item 10                 | preset_second                         |
| Measurement                  | Seconds                               |
| Units                        | Seconds                               |
| Values Range                 | 0 .. 59                               |
| Invalid Value                | N/A                                   |
| Data Item 11                 | preset_millisec                       |
| Measurement                  | Milliseconds                          |
| Units                        | Milliseconds                          |
| Values Range                 | 0 .. 999                              |
| Invalid Value                | N/A                                   |
| <b>SNVT_press</b>            |                                       |
| Data Length                  | 1                                     |
| Suggested Data Array Formats | Float                                 |
| Data Item 1                  |                                       |
| Measurement                  | Pressure (gauge)                      |
| Units                        | KiloPascals                           |
| Values Range                 | -3,276.8 .. 3,276.6                   |
| Invalid Value                | Type: 3,276.7    Raw: 32,767 (0x7FFF) |

|                              |                           |
|------------------------------|---------------------------|
| <b>SNVT_press_f</b>          |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Float                     |
| Data Item 1                  |                           |
| Measurement                  | Pressure (gauge)          |
| Units                        | Pascals                   |
| Values Range                 | -3.40282E38 .. 3.40282E38 |
| Invalid Value                | N/A                       |
| <b>SNVT_press_p</b>          |                           |
| Data Length                  | 1                         |
| Suggested Data Array Formats | Sint16, Float             |
| Data Item 1                  |                           |
| Measurement                  | Pressure (gauge)          |
| Units                        | Pascals                   |
| Values Range                 | -32,768 .. 32,766         |
| Invalid Value                | 32,767 (0x7FFF)           |
| <b>SNVT_privacyzone</b>      |                           |
| Data Length                  | 3                         |
| Suggested Data Array Formats | Uint16, Float             |
| Data Item 1                  | priv_zn_action            |
| Measurement                  | privacyzone_t             |
| Units                        | N/A                       |
| Values Range                 | 0 .. 5                    |
| Invalid Value                | 255 (0xFF)(PZ_NUL)        |
| Data Item 2                  | priv_zn_number            |
| Measurement                  | Zone number               |
| Units                        | Privacy zone number       |
| Values Range                 | 1 .. 255                  |
| Invalid Value                | 0                         |
| Data Item 3                  | priv_zn_camera_id         |
| Measurement                  | Camera ID                 |
| Units                        | ID number                 |
| Values Range                 | 1 .. 65,535               |
| Invalid Value                | 0                         |

|                              |                            |
|------------------------------|----------------------------|
| <b>SNVT_ptz</b>              |                            |
| Data Length                  | 6                          |
| Suggested Data Array Formats | Float                      |
| Data Item 1                  | ptz_pan_dir                |
| Measurement                  | pan_dir_t                  |
| Units                        | N/A                        |
| Values Range                 | 0 .. 2                     |
| Invalid Value                | 255 (0xFF)(PAN_NUL)        |
| Data Item 2                  | ptz_pan_speed              |
| Measurement                  | Pan speed                  |
| Units                        | Percent of full level      |
| Values Range                 | 0.0 .. 100.0               |
| Invalid Value                | N/A                        |
| Data Item 3                  | ptz_tilt_dir               |
| Measurement                  | tilt_dir_t                 |
| Units                        | N/A                        |
| Values Range                 | 0 .. 2                     |
| Invalid Value                | 255 (0xFF)(TILT_NUL)       |
| Data Item 4                  | ptz_tilt_speed             |
| Measurement                  | Tilt speed                 |
| Units                        | Percent of full level      |
| Values Range                 | 0.0 .. 100.0               |
| Invalid Value                | N/A                        |
| Data Item 5                  | ptz_zoom                   |
| Measurement                  | zoom_t                     |
| Units                        | N/A                        |
| Values Range                 | 0 .. 2                     |
| Invalid Value                | 255 (0xFF)(ZOOM_NUL)       |
| Data Item 6                  | ptz_zoom_speed             |
| Measurement                  | Zoom speed                 |
| Units                        | Percent of full level      |
| Values Range                 | 0.0 .. 100.0               |
| Invalid Value                | N/A                        |
| <b>SNVT_pump_sensor</b>      |                            |
| Data Length                  | 13                         |
| Suggested Data Array Formats | Float                      |
| Data Item 1                  | pump_sn_rot_speed          |
| Measurement                  | Frequency                  |
| Units                        | Hertz                      |
| Values Range                 | 0 .. 6,553.4               |
| Invalid Value                | N/A                        |
| Data Item 2                  | pump_sn_body_temp          |
| Measurement                  | Body temperature           |
| Units                        | Degrees celcius            |
| Values Range                 | -274.0 .. 6,279.4          |
| Invalid Value                | N/A                        |
| Data Item 3                  | pump_sn_mot_ext_temp       |
| Measurement                  | Motor external temperature |
| Units                        | Degrees celcius            |
| Values Range                 | -274.0 .. 6,279.4          |
| Invalid Value                | N/A                        |
| Data Item 4                  | pump_sn_mot_int_temp       |
| Measurement                  | Motor internal temperature |

|               |                        |
|---------------|------------------------|
| Units         | Degrees celcius        |
| Values Range  | -274.0 .. 6,279.4      |
| Invalid Value | N/A                    |
| Data Item 5   | pump_sn_mot_overload   |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |
| Data Item 6   | pump_sn_oil_low        |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |
| Data Item 7   | pump_sn_ph_imbal       |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |
| Data Item 8   | pump_sn_curr_use       |
| Measurement   | Electric current usage |
| Units         | Ampere                 |
| Values Range  | -3,276.8 .. 3,276.6    |
| Invalid Value | N/A                    |
| Data Item 9   | pump_sn_pwr_usage      |
| Measurement   | Power usage            |
| Units         | Kilowatts              |
| Values Range  | 0 .. 6,553.4           |
| Invalid Value | N/A                    |
| Data Item 10  | pump_sn_temp_ctrl      |
| Measurement   | unit temp t            |
| Units         | N/A                    |
| Values Range  | 0 .. 3                 |
| Invalid Value | 255 (0xFF)(TEMP_NUL)   |
| Data Item 11  | pump_sn_em_brake_act   |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |
| Data Item 12  | pump_sn_fric_brk_act   |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |
| Data Item 13  | pump_sn_gas_brk_act    |
| Measurement   | Boolean                |
| Units         | Bit                    |
| Values Range  | 0, 1                   |
| Invalid Value | 255 (0xFF)(BOOL_NUL)   |

| SNVT_pumpset_mn              |                       |
|------------------------------|-----------------------|
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  | pset_main_pump        |
| Measurement                  | motor_state_t         |
| Units                        | N/A                   |
| Values Range                 | 0 .. 7                |
| Invalid Value                | 255 (0xFF)(MOTOR_NUL) |
| Data Item 2                  | pset_booster_pump     |
| Measurement                  | motor_state_t         |
| Units                        | N/A                   |
| Values Range                 | 0 .. 7                |
| Invalid Value                | 255 (0xFF)(MOTOR_NUL) |
| Data Item 3                  | pset_prio_level       |
| Measurement                  | priority_level_t      |
| Units                        | N/A                   |
| Values Range                 | 0 .. 11               |
| Invalid Value                | 255 (0xFF)(PR_NUL)    |
| Data Item 4                  | pset_process_ready    |
| Measurement                  | oolean_t              |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 5                  | pset_emerg_stop       |
| Measurement                  | oolean_t              |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 6                  | pset_main_pumpd_ena   |
| Measurement                  | oolean_t              |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 7                  | pset_boost_pumpd_ena  |
| Measurement                  | oolean_t              |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 8                  | pset_maint_req        |
| Measurement                  | oolean_t              |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |

| SNVT_pumpset_sn              |                            |
|------------------------------|----------------------------|
| Data Length                  | 14                         |
| Suggested Data Array Formats | Float                      |
| Data Item 1                  | pset_sn_dil_flow           |
| Measurement                  | Total Dilution Flow Volume |
| Units                        | Milliliters per second     |
| Values Range                 | 0 .. 65,534                |
| Invalid Value                | N/A                        |
| Data Item 2                  | pset_sn_exh_temp           |
| Measurement                  | Exhaust Temperature        |
| Units                        | Degrees Celcius            |
| Values Range                 | -274.0 .. 6,279.4          |
| Invalid Value                | N/A                        |
| Data Item 3                  | pset_sn_exh_press          |
| Measurement                  | Exhaust Pressure           |
| Units                        | Kilo-pascals               |
| Values Range                 | -3,276.8 .. 3,276.6        |
| Invalid Value                | N/A                        |
| Data Item 4                  | pset_sn_seal_press         |
| Measurement                  | Shaft seal purge pressure  |
| Units                        | Kilo-pascals               |
| Values Range                 | -3,276.8 .. 3,276.6        |
| Invalid Value                | N/A                        |
| Data Item 5                  | pset_sn_inlet_vacuum       |
| Measurement                  | Inlet vacuum pressure      |
| Units                        | Kilo-pascals               |
| Values Range                 | -3.40282E38 .. 3.40282E38  |
| Invalid Value                | N/A                        |
| Data Item 6                  | pset_sn_supply_volts       |
| Measurement                  | Supply voltage             |
| Units                        | Volts                      |
| Values Range                 | -3,276.8 .. 3,276.6        |
| Invalid Value                | N/A                        |
| Data Item 7                  | pset_sn_cool_flow          |
| Measurement                  | Total coolant flow         |
| Units                        | Milliliters per second     |
| Values Range                 | 0 .. 65,534                |
| Invalid Value                | N/A                        |
| Data Item 8                  | pset_sn_cool_fl_low        |
| Measurement                  | Boolean                    |
| Units                        | Bit                        |
| Values Range                 | 0, 1                       |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)       |
| Data Item 9                  | pset_sn_dil_active         |
| Measurement                  | Boolean                    |
| Units                        | Bit                        |
| Values Range                 | 0, 1                       |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)       |
| Data Item 10                 | pset_sn_bal_dil_act        |
| Measurement                  | Boolean                    |
| Units                        | Bit                        |
| Values Range                 | 0, 1                       |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)       |

|                              |                       |
|------------------------------|-----------------------|
| Data Item 11                 | pset_sn_inl_p_dil_act |
| Measurement                  | Boolean               |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 12                 | pset_sn_exh_dil_act   |
| Measurement                  | Boolean               |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 13                 | pset_sn_dil_fl_oor    |
| Measurement                  | Boolean               |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| Data Item 14                 | pset_sn_pwr_sup_on    |
| Measurement                  | Boolean               |
| Units                        | Bit                   |
| Values Range                 | 0, 1                  |
| Invalid Value                | 255 (0xFF)(BOOL_NUL)  |
| <b>SNVT_pwr_fact</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Power Factor          |
| Units                        | Multiplier            |
| Values Range                 | -1.00000 .. 1.00000   |
| Invalid Value                | N/A                   |
| <b>SNVT_pwr_fact_f</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Power Factor          |
| Units                        | N/A                   |
| Values Range                 | -1 .. 1               |
| Invalid Value                | N/A                   |

| SNVT_reg_val                 |                                  |
|------------------------------|----------------------------------|
| Data Length                  | 3                                |
| Suggested Data Array Formats | Sint32                           |
| Data Item 1                  | reg_val_value                    |
| Measurement                  | Raw value                        |
| Units                        | Defined by unit field            |
| Values Range                 | -2,147,483,638 .. 2,147,483,647  |
| Invalid Value                | N/A                              |
| Data Item 2                  | reg_val_unit                     |
| Measurement                  | reg_val_unit_t                   |
| Units                        | N/A                              |
| Values Range                 | 0 .. 43                          |
| Invalid Value                | 255 (0xFF)(RVU_NUL)              |
| Data Item 3                  | reg_val_decimals                 |
| Measurement                  | Decimal Place                    |
| Units                        | Digits to Right of Decimal Point |
| Values Range                 | 0 ..7                            |
| Invalid Value                | N/A                              |

| SNVT_reg_val_ts              |                                 |
|------------------------------|---------------------------------|
| Data Length                  | 9                               |
| Suggested Data Array Formats | Sint32                          |
| Data Item 1                  | reg_val_ts_raw                  |
| Measurement                  | Raw Value                       |
| Units                        |                                 |
| Values Range                 | -2,147,483,648 .. 2,147,483,647 |
| Invalid Value                | N/A                             |
| Data Item 2                  | reg_val_ts_unit                 |
| Measurement                  | reg_val_unit_t                  |
| Units                        | N/A                             |
| Values Range                 | 0 .. 43                         |
| Invalid Value                | 255 (0xFF)(RVU_NUL)             |
| Data Item 3                  | reg_val_ts_bits                 |
| Measurement                  | See SNVT tables                 |
| Units                        | See SNVT tables                 |
| Values Range                 | 0 .. 255                        |
| Invalid Value                | N/A                             |
| Data Item 4                  | reg_val_ts_year                 |
| Measurement                  | Year                            |
| Units                        | Year                            |
| Values Range                 | 0 .. 300                        |
| Invalid Value                | N/A                             |
| Data Item 5                  | reg_val_ts_month                |
| Measurement                  | Month                           |
| Units                        | Month of Year                   |
| Values Range                 | 0 .. 12                         |
| Invalid Value                | N/A                             |
| Data Item 6                  | reg_val_ts_day                  |
| Measurement                  | Day                             |
| Units                        | Day of Month                    |
| Values Range                 | 0 .. 31                         |
| Invalid Value                | N/A                             |
| Data Item 7                  | reg_val_ts_hour                 |
| Measurement                  | Hour                            |
| Units                        | Hour of day                     |
| Values Range                 | 0 .. 23                         |
| Invalid Value                | N/A                             |
| Data Item 8                  | reg_val_ts_min                  |
| Measurement                  | Minutes                         |
| Units                        | Minute of Hour                  |
| Values Range                 | 0 .. 59                         |
| Invalid Value                | N/A                             |
| Data Item 9                  | reg_val_ts_secs                 |
| Measurement                  | Second                          |
| Units                        | Second of minute                |
| Values Range                 | 0 .. 59                         |
| Invalid Value                | N/A                             |

|                              |                              |
|------------------------------|------------------------------|
| <b>SNVT_res</b>              |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Float                        |
| Data Item 1                  |                              |
| Measurement                  | Electrical Resistance        |
| Units                        | Ohms                         |
| Values Range                 | 0 .. 6,553.5                 |
| Invalid Value                | N/A                          |
| <b>SNVT_res_f</b>            |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Float                        |
| Data Item 1                  |                              |
| Measurement                  | Electrical Resistance        |
| Units                        | Ohms                         |
| Values Range                 | 0 .. 3.40282E38              |
| Invalid Value                | N/A                          |
| <b>SNVT_res_kilo</b>         |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Float                        |
| Data Item 1                  |                              |
| Measurement                  | Electrical Resistance        |
| Units                        | KiloOhms                     |
| Values Range                 | 0 .. 6,553.5                 |
| Invalid Value                | N/A                          |
| <b>SNVT_rpm</b>              |                              |
| Data Length                  | 1                            |
| Suggested Data Array Formats | Uint16, Float                |
| Data Item 1                  |                              |
| Measurement                  | Angular Velocity             |
| Units                        | Revolutions per Minute (RPM) |
| Values Range                 | 0 .. 65,534                  |
| Invalid Value                | 65,535 (0xFFFF)              |
| <b>SNVT_scene</b>            |                              |
| Data Length                  | 2                            |
| Suggested Data Array Formats | Byte, Uint16, Float          |
| Data Item 1                  | Function                     |
| Measurement                  | Scene_t                      |
| Units                        | N/A                          |
| Values Range                 | 0 .. 23                      |
| Invalid Value                | 255 (0xFF)(SC_NUL)           |
| Data Item 2                  | Scene_Number                 |
| Measurement                  | Scene Number                 |
| Units                        | Scene Number                 |
| Values Range                 | 1 .. 255                     |
| Invalid Value                | N/A                          |

| <b>SNVT_scene_cfg</b>        |                                   |
|------------------------------|-----------------------------------|
| Data Length                  | 7                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  | scn_cfg_func                      |
| Measurement                  | scene_config_t                    |
| Units                        | N/A                               |
| Values Range                 | 0 .. 4                            |
| Invalid Value                | 255 (0xFF)(SCF_NUL)               |
| Data Item 2                  | scn_cfg_scene                     |
| Measurement                  | Scene Number                      |
| Units                        | Scene Number                      |
| Values Range                 | 1 .. 255                          |
| Invalid Value                | N/A                               |
| Data Item 3                  | scn_cfg_setting                   |
| Measurement                  | Scene Setting Level               |
| Units                        | Percent of Full Level             |
| Values Range                 | 0 .. 100.0                        |
| Invalid Value                | N/A                               |
| Data Item 4                  | scn_cfg_rotation                  |
| Measurement                  | Scene Rotation Angle              |
| Units                        | Degrees                           |
| Values Range                 | -359.98 .. 360.00                 |
| Invalid Value                | Raw: 32,767 (0x7FFF) Type: 655.34 |
| Data Item 5                  | scn_cfg_fade_tim                  |
| Measurement                  | Scene Fade Time                   |
| Units                        | Seconds                           |
| Values Range                 | 0.0 to 6,553.4                    |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 6553.5 |
| Data Item 6                  | scn_cfg_dly_tim                   |
| Measurement                  | Scene Delay Time                  |
| Units                        | Seconds                           |
| Values Range                 | 0.0 to 6,553.4                    |
| Invalid Value                | Raw: 65,535 (0xFFFF) Type: 6553.5 |
| Data Item 7                  | scn_cfg_scn_proi                  |
| Measurement                  | Scene Priority                    |
| Units                        | Priority Value                    |
| Values Range                 | 0 .. 255                          |
| Invalid Value                | N/A                               |

|                              |                                      |
|------------------------------|--------------------------------------|
| <b>SNVT_setting</b>          |                                      |
| Data Length                  | 3                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  | setting_function                     |
| Measurement                  | setting_t                            |
| Units                        | N/A                                  |
| Values Range                 | 0 .. 5                               |
| Invalid Value                | 255 (0xFF)(SET_NUL)                  |
| Data Item 2                  | setting_setting                      |
| Measurement                  | Scene Setting Level                  |
| Units                        | Percent of Full Level                |
| Values Range                 | 0 .. 100.0                           |
| Invalid Value                | N/A                                  |
| Data Item 3                  | setting_rotation                     |
| Measurement                  | Rotation Angle                       |
| Units                        | Degrees                              |
| Values Range                 | -359.98 .. 360.00                    |
| Invalid Value                | Raw: (0xFFFF) 32,767    Type: 655.34 |
| <b>SNVT_smo_obscur</b>       |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Smoke Obscuration                    |
| Units                        | Percent Obscuration                  |
| Values Range                 | 0.000 .. 5.000                       |
| Invalid Value                | N/A                                  |
| <b>SNVT_sound_db</b>         |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Sound Level                          |
| Units                        | Decibels                             |
| Values Range                 | -327.68 .. 327.67                    |
| Invalid Value                | N/A                                  |
| <b>SNVT_sound_db_f</b>       |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Sound Level                          |
| Units                        | Decibels from Sound Pressure Level   |
| Values Range                 | -3.40282E38 .. 3.40282E38            |
| Invalid Value                | N/A                                  |
| <b>SNVT_speed</b>            |                                      |
| Data Length                  | 1                                    |
| Suggested Data Array Formats | Float                                |
| Data Item 1                  |                                      |
| Measurement                  | Linear Velocity                      |
| Units                        | Meters per Second                    |
| Values Range                 | 0 .. 6,553.5                         |
| Invalid Value                | N/A                                  |

|                              |                                  |
|------------------------------|----------------------------------|
| <b>SNVT_speed_f</b>          |                                  |
| Data Length                  | 1                                |
| Suggested Data Array Formats | Float                            |
| Data Item 1                  |                                  |
| Measurement                  | Speed                            |
| Units                        | Meters per Second                |
| Values Range                 | -3.40282E38 .. 3.40282E38        |
| Invalid Value                | N/A                              |
| <b>SNVT_speed_mil</b>        |                                  |
| Data Length                  | 1                                |
| Suggested Data Array Formats | Float                            |
| Data Item 1                  |                                  |
| Measurement                  | Linear Velocity                  |
| Units                        | Millimeters per Second           |
| Values Range                 | 0 .. 65.535                      |
| Invalid Value                | N/A                              |
| <b>SNVT_state</b>            |                                  |
| Data Length                  | 1                                |
| Suggested Data Array Formats | Uint16, Float                    |
| Data Item 1                  |                                  |
| Measurement                  | 16 state bits                    |
| Units                        | Bits                             |
| Values Range                 | 0 .. 65,535                      |
| Invalid Value                | N/A                              |
| <b>SNVT_state_64</b>         |                                  |
| Data Length                  | 4                                |
| Suggested Data Array Formats | Packed_Bit, Uint16, Float        |
| Data Item 1                  | state_64_word0                   |
| Measurement                  | Boolean                          |
| Units                        | Bit                              |
| Values Range                 | 0, 1 per bit ( 16 bits in word ) |
| Invalid Value                | N/A                              |
| Data Item 2                  | state_64_word1                   |
| Measurement                  | Boolean                          |
| Units                        | Bit                              |
| Values Range                 | 0, 1 per bit ( 16 bits in word ) |
| Invalid Value                | N/A                              |
| Data Item 3                  | state_64_word2                   |
| Measurement                  | Boolean                          |
| Units                        | Bit                              |
| Values Range                 | 0, 1 per bit ( 16 bits in word ) |
| Invalid Value                | N/A                              |
| Data Item 4                  | state_64_word3                   |
| Measurement                  | Boolean                          |
| Units                        | Bit                              |
| Values Range                 | 0, 1 per bit ( 16 bits in word ) |
| Invalid Value                | N/A                              |

|                              |                                            |
|------------------------------|--------------------------------------------|
| <b>SNVT_str_asc</b>          |                                            |
| Data Length                  | 31                                         |
| Suggested Data Array Formats | Byte, Uint16, Float                        |
| Data Item 1 – 31             | ascii00, ascii01, .. ascii30               |
| Measurement                  | Character String                           |
| Units                        | N/A                                        |
| Values Range                 | 0 .. 255                                   |
| Invalid Value                | N/A                                        |
| <b>SNVT_str_int</b>          |                                            |
| Data Length                  | 16                                         |
| Suggested Data Array Formats | Uint16, Float                              |
| Data Item 1                  | char_set                                   |
| Measurement                  | Locale Code                                |
| Units                        | N/A                                        |
| Values Range                 | 0 .. 255                                   |
| Invalid Value                | N/A                                        |
| Data Item 2-16               | wide_char00, .. wide_char14                |
| Measurement                  | Wide-character string with NULL terminator |
| Units                        | N/A                                        |
| Values Range                 | 0 .. 65,535                                |
| Invalid Value                | N/A                                        |
| <b>SNVT_switch</b>           |                                            |
| Data Length                  | 2                                          |
| Suggested Data Array Formats | Float                                      |
| Data Item 1                  | Value                                      |
| Measurement                  | Value                                      |
| Units                        | Percentage of full scale                   |
| Values Range                 | 0 .. 100.0                                 |
| Invalid Value                | N/A                                        |
| Data Item 2                  | State                                      |
| Measurement                  | State                                      |
| Units                        | N/A                                        |
| Values Range                 | 0 .. 1                                     |
| Invalid Value                | -1                                         |
| <b>SNVT_telcom</b>           |                                            |
| Data Length                  | 1                                          |
| Suggested Data Array Formats | Byte, Uint16, Float                        |
| Data Item 1                  |                                            |
| Measurement                  | telcom_states_t                            |
| Units                        | N/A                                        |
| Values Range                 | 0 .. 20                                    |
| Invalid Value                | 255 (0xFF)(TEL_NUL)                        |
| <b>SNVT_temp</b>             |                                            |
| Data Length                  | 1                                          |
| Suggested Data Array Formats | Float                                      |
| Data Item 1                  |                                            |
| Measurement                  | Temperature                                |
| Units                        | Degrees Celsius                            |
| Values Range                 | -274.0 .. 6,279.5                          |
| Invalid Value                | N/A                                        |

|                              |                                        |
|------------------------------|----------------------------------------|
| <b>SNVT_temp_diff_p</b>      |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Temperature difference                 |
| Units                        | Degrees Celcius                        |
| Values Range                 | -327.68 .. 327.66                      |
| Invalid Value                | Raw: 32,767 (0x7FFF)<br>Type: 327.67   |
| <b>SNVT_temp_f</b>           |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Incremental Count                      |
| Units                        | Degrees Celcius                        |
| Values Range                 | -3.40282E38 .. 3.40282E38              |
| Invalid Value                | N/A                                    |
| <b>SNVT_temp_p</b>           |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Temperature                            |
| Units                        | Degrees celsius                        |
| Values Range                 | -273.17 .. 327.66                      |
| Invalid Value                | Type: 327.67    Raw: 32,767 (0x7FFF)   |
| <b>SNVT_temp_ror</b>         |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Temperature Rate of Change/Rise        |
| Units                        | Degrees Celsius per Minute (°C/min)    |
| Values Range                 | -16,384.0 .. 16,383.0                  |
| Invalid Value                | Raw: 32,767 (0x7FFF)    Type: 16,383.5 |

|                              |                                   |
|------------------------------|-----------------------------------|
| <b>SNVT_temp_setpt</b>       |                                   |
| Data Length                  | 6                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  | Occupied_cool                     |
| Measurement                  | Occupied Cooling Setpoint         |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| Data Item 2                  | Standby_cool                      |
| Measurement                  | Standby Cooling Setpoint          |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| Data Item 3                  | Unoccupied_cool                   |
| Measurement                  | Unoccupied Cooling Setpoint       |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| Data Item 4                  | Occupied_heat                     |
| Measurement                  | Occupied Heating Setpoint         |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| Data Item 5                  | Standby_heat                      |
| Measurement                  | Standby Heating Setpoint          |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| Data Item 6                  | Unoccupied_heat                   |
| Measurement                  | Unoccupied Heating Setpoint       |
| Units                        | Degrees Celsius                   |
| Values Range                 | -273.17 .. 327.66                 |
| Invalid Value                | Type: 327.67 Raw: 32,767 (0x7FFF) |
| <b>SNVT_therm_mode</b>       |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Byte, Uint16, Float               |
| Data Item 1                  |                                   |
| Measurement                  | therm_mode_t                      |
| Units                        | N/A                               |
| Values Range                 | 0 .. 2                            |
| Invalid Value                | 255 (0xFF)(THERM_NUL)             |
| <b>SNVT_time_f</b>           |                                   |
| Data Length                  | 1                                 |
| Suggested Data Array Formats | Float                             |
| Data Item 1                  |                                   |
| Measurement                  | Elapsed Time                      |
| Units                        | Seconds                           |
| Values Range                 | -3.40282E38 .. 3.40282E38         |
| Invalid Value                | N/A                               |

|                              |                 |
|------------------------------|-----------------|
| <b>SNVT_time_hour</b>        |                 |
| Data Length                  | 1               |
| Suggested Data Array Formats | Uint16, Float   |
| Data Item 1                  |                 |
| Measurement                  | Elapsed Time    |
| Units                        | Hours           |
| Values Range                 | 0 .. 65,535     |
| Invalid Value                | N/A             |
| <b>SNVT_time_min</b>         |                 |
| Data Length                  | 1               |
| Suggested Data Array Formats | Uint16, Float   |
| Data Item 1                  |                 |
| Measurement                  | Elapsed Time    |
| Units                        | Minutes         |
| Values Range                 | 0 .. 65,535     |
| Invalid Value                | N/A             |
| <b>SNVT_time_sec</b>         |                 |
| Data Length                  | 1               |
| Suggested Data Array Formats | Float           |
| Data Item 1                  |                 |
| Measurement                  | Elapsed time    |
| Units                        | Seconds         |
| Values Range                 | 0 .. 6,553.4    |
| Invalid Value                | 65,535 (0xFFFF) |

|                                                 |                  |
|-------------------------------------------------|------------------|
| <b>SNVT_time_stamp</b>                          |                  |
| Data Length                                     | 6                |
| Suggested Data Array Formats                    | Uint16, Float    |
| Data Item 1                                     | ts_year          |
| Measurement                                     | Year             |
| Units                                           | Year             |
| Values Range                                    | 0 .. 3000        |
| Invalid Value                                   | 65,535 (0xFFFF)  |
| Data Item 2                                     | ts_month         |
| Measurement                                     | Month            |
| Units                                           | Month of Year    |
| Values Range                                    | 0 .. 12          |
| Invalid Value                                   | N/A              |
| Data Item 3                                     | ts_day           |
| Measurement                                     | Day              |
| Units                                           | Day of Month     |
| Values Range                                    | 0 .. 31          |
| Invalid Value                                   | N/A              |
| Data Item 4                                     | ts_hour          |
| Measurement                                     | Hours            |
| Units                                           | Hours of Day     |
| Values Range                                    | 0 .. 23          |
| Invalid Value                                   | N/A              |
| Data Item 5                                     | ts_minute        |
| Measurement                                     | Minutes          |
| Units                                           | Minute of Hour   |
| Values Range                                    | 0 .. 59          |
| Invalid Value                                   | N/A              |
| Data Item 6                                     | ts_second        |
| Measurement                                     | Second           |
| Units                                           | Second of Minute |
| Values Range                                    | 0 .. 59          |
| Invalid Value                                   | N/A              |
| <b>SNVT_time_zone (only raw data supported)</b> |                  |
| Data Length                                     | 15               |
| Suggested Data Array Formats                    | Byte             |

|                              |                                     |
|------------------------------|-------------------------------------|
| <b>SNVT_tod_event</b>        |                                     |
| Data Length                  | 3                                   |
| Suggested Data Array Formats | Uint16, Float                       |
| Data Item 1                  | tod_cur_state                       |
| Measurement                  | occup_t                             |
| Units                        | N/A                                 |
| Values Range                 | 0 .. 3                              |
| Invalid Value                | 255 (0xFF)(OC_NUL)                  |
| Data Item 2                  | tod_nxt_state                       |
| Measurement                  | occup_t                             |
| Units                        | N/A                                 |
| Values Range                 | 0 .. 3                              |
| Invalid Value                | 255 (0xFF)(OC_NUL)                  |
| Data Item 3                  | tod_tm_to_nxt                       |
| Measurement                  | Time to Next State                  |
| Units                        | Minute of Hour                      |
| Values Range                 | 0 .. 65,535                         |
| Invalid Value                | N/A                                 |
| <b>SNVT_trans_table</b>      |                                     |
| Data Length                  | 8                                   |
| Suggested Data Array Formats | Float                               |
| Data Item 1-7                | tr_point00, ..tr_point06            |
| Measurement                  | Axis-points Array                   |
| Units                        | N/A                                 |
| Values Range                 | -3.40282E38 .. 3.40282E38           |
| Invalid Value                | N/A                                 |
| Data Item 8                  | interp_methods                      |
| Measurement                  | interp_t                            |
| Units                        | N/A                                 |
| Values Range                 | 0 .. 65,535                         |
| Invalid Value                | N/A                                 |
| <b>SNVT_turbidity</b>        |                                     |
| Data Length                  | 1                                   |
| Suggested Data Array Formats | Float                               |
| Data Item 1                  |                                     |
| Measurement                  | Turbidity                           |
| Units                        | Nephelometric Turbidity Units (NTU) |
| Values Range                 | 0 .. 65,534                         |
| Invalid Value                | 65,535 (0xFFFF)                     |
| <b>SNVT_turbidity_f</b>      |                                     |
| Data Length                  | 1                                   |
| Suggested Data Array Formats | Float                               |
| Data Item 1                  |                                     |
| Measurement                  | Turbidity                           |
| Units                        | Nephelometric Turbidity Units (NTU) |
| Values Range                 | 0 .. 3.40282E38                     |
| Invalid Value                | N/A                                 |

|                              |                       |
|------------------------------|-----------------------|
| <b>SNVT_valve_mode</b>       |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Byte, Uint16, Float   |
| Data Item 1                  |                       |
| Measurement                  | valve_mode_t          |
| Units                        | N/A                   |
| Values Range                 | 0 .. 7                |
| Invalid Value                | 255 (0xFF)(VALVE_NUL) |
| <b>SNVT_vol</b>              |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Volume                |
| Units                        | Liters                |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_vol_f</b>            |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Volume                |
| Units                        | Liters                |
| Values Range                 | 0 .. 3.40282E38       |
| Invalid Value                | N/A                   |
| <b>SNVT_vol_kilo</b>         |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Volume                |
| Units                        | Kiloliters (kl)       |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_vol_mil</b>          |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Volume                |
| Units                        | Milliliters           |
| Values Range                 | 0 .. 6,553.5          |
| Invalid Value                | N/A                   |
| <b>SNVT_volt</b>             |                       |
| Data Length                  | 1                     |
| Suggested Data Array Formats | Float                 |
| Data Item 1                  |                       |
| Measurement                  | Electric Voltage      |
| Units                        | Volts                 |
| Values Range                 | -3,276.8 ... 3,276.7  |
| Invalid Value                | N/A                   |

|                              |                                        |
|------------------------------|----------------------------------------|
| <b>SNVT_volt_ac</b>          |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Uint16, Float                          |
| Data Item 1                  |                                        |
| Measurement                  | Electric Voltage                       |
| Units                        | Volts, Alternating Current (VAC)       |
| Values Range                 | 0 .. 65,534                            |
| Invalid Value                | 65,535 (0xFFFF)                        |
| <b>SNVT_volt_dbmv</b>        |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Electric Voltage                       |
| Units                        | Decibels-milliVolts, Direct Current    |
| Values Range                 | -3,276.8 .. 3,276.7                    |
| Invalid Value                | N/A                                    |
| <b>SNVT_volt_f</b>           |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Electric Voltage                       |
| Units                        | Volts                                  |
| Values Range                 | -3.40282E38 .. 3.40282E38              |
| Invalid Value                | N/A                                    |
| <b>SNVT_volt_kilo</b>        |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Electric Voltage                       |
| Units                        | Kilovolts                              |
| Values Range                 | -3,276.8 .. 3,276.7                    |
| Invalid Value                | N/A                                    |
| <b>SNVT_volt_mil</b>         |                                        |
| Data Length                  | 1                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  |                                        |
| Measurement                  | Electric Voltage                       |
| Units                        | Millivolts                             |
| Values Range                 | -3,276.8 .. 3,276.7                    |
| Invalid Value                | N/A                                    |
| <b>SNVT_zerospan</b>         |                                        |
| Data Length                  | 2                                      |
| Suggested Data Array Formats | Float                                  |
| Data Item 1                  | zero                                   |
| Measurement                  | Zero-term                              |
| Units                        | Percent (%) or Parts-per-Million (ppm) |
| Values Range                 | -163.840 .. 163.835                    |
| Invalid Value                | N/A                                    |
| Data Item 2                  | span                                   |
| Measurement                  | Span-factor                            |
| Units                        | Percent (%) or Parts-per-Million (ppm) |
| Values Range                 | 0 .. 32.7675                           |
| Invalid Value                | N/A                                    |

## Appendix A.4. Using UNVTs

UNVT's are User-defined Network Variable Types and are defined in the configuration file by filling the SNVT\_Type field with "UNVT\_FST" or "Not SNVT". The UNVT's size in bytes should also be added to the UNVT\_Byte\_Length field and the UNVT's type number in the UNVT\_ID field. Valid UNVT\_IDs range from 146 to 255 and 0. The UNVT\_ID value will be substituted with the default value of 0 if the field is left empty.

## Appendix A.5. Using NV\_Min\_Value, NV\_Max\_Value Fields

The NV\_Min\_Value, NV\_Max\_Value functionality were added to stop the propagation of 'out of bounds' network variables across a LonWorks network. NV values higher than assigned by the NV\_Max\_Value field or lower than assigned by NV\_Min\_Value field will not be sent out on the network or copied to their relevant Data Arrays. If one or both of these fields are not assigned values, limit checking will not be performed on that particular field. This functionality applies only to SNVT's of either Floating point or Integer formats.

One or both of these fields can be linked to a configuration network variable update input in order to create an interoperable configuration property. For further information refer to Appendix A.13

## Appendix A.6. Sending Network Variable Updates in Throttling Mode

When the Lon\_Function field specifies a Throttling Mode Client Map Descriptor the NV\_Delta\_Value, Min\_Scan\_Time and Max\_Scan\_Time fields *all* need to be assigned values.

When operating in Throttling Mode, a Network Variable's value will be sampled at the Min\_Scan\_Time period. If the value differs by an amount greater than or equal to that specified by the NV\_Delta\_Value field from the previously transmitted value, the NV update will be transmitted. Otherwise an NV update will be only sent if the time since the last update is greater than or equal to the Max\_Scan\_Time field value.

This functionality applies only to SNVT's of either Floating point or Integer formats.

## Appendix A.7. Using SNVT\_Index

The SNVT\_Index field must be specified for all explicitly addressed Client Map Descriptors. Explicitly addressed Client Map Descriptors use this field to index their relevant Map Descriptors on the Server side. For implicitly addressed Client Map Descriptors and all Server side Map Descriptors the driver will assign an index to each one, starting from 0 and incrementing to 4095, in the order they appear in the configuration file.

## Appendix A.8. Domain Table Setup

To be able to communicate with other nodes on the LonWorks network, the FieldServer must have its domain, subnet and node IDs set. The FieldServer has the option of writing its domain table at start-up or leaving it for management by network management tools. In

other words, the user is able to set the FieldServer's domain, subnet and node id without the help of a network management tool. This feature is enabled in the configuration file by filling out the Title and System\_Address fields of the FieldServer parameters as follows:

|                         |                                                   |
|-------------------------|---------------------------------------------------|
| FieldServer             |                                                   |
| System_Station_Address, | Title                                             |
| [node_id],              | “:D[domain_id]:S[subnet_id]:[Title continued...]” |

The Title field must start with “:D”, followed by the domain\_id in hexadecimal notation, followed by “:S”, followed by the subnet\_id in hexadecimal notation and enclosed by “:”. The domain length is automatically determined by the number of digits in the [domain\_id] field. With 2 hexadecimal digits constituting 1 byte, “:D123456:” for example would have a length of 3.

Once the domain table has been set, the “:Dxx:Sxx:” part of the Title field will be removed. Now the Title field will be left with [Title continued...] which may be the Node self-documentation string or any title.

### Appendix A.9. Using LonMaker to commission the FieldServer

- Ensure that the correct firmware and latest configuration is loaded on the FieldServer (Each change in the FieldServer requires re-commissioning of the FieldServer in LonMaker)
- Ensure that the FieldServer and the LonMaker machine are on the same network.
- Open the existing Network in LonMaker, or create a new Network
- Click on “Create New Network” and follow the network wizard, making the following selections:
  - Network Interface: Choose Network Attached
  - Management Mode: Choose Onnet unless you are working offline
  - Register Plug-ins required. None
- Once Visio is open with the Network showing, drag a new device onto the drawing from the toolbox.
- Follow the Device Network, making the following selections
  - Enter Device Name: Choose commission device
  - Specify Device Template: Choose upload from device
  - Specify Device Channel: Choose Auto Detect
  - Specify Device Properties: Leave as is (Ping is optional)
  - Identify Device: Choose service pin
  - Device Application Image: Leave unchecked
  - Initial State: Leave as is
- Press the service pin on the FieldServer when asked to do so, and the FieldServer will be commissioned.
- Drag a new function block onto the drawing from the toolbox. Give the function block a name and ensure that it is allocated to the FieldServer device.
- Once the function block is on the drawing, you can drag input and output variables onto the function block. When you do this, LonMaker will show you the variables available for binding. Click on the variables you require (or use the select all option), and they will be commissioned onto the function block.
- You are now ready to connect these variables to other devices by dragging connections from the toolbox and connecting the variables.

### **Appendix A.10. Note for Trane Rover Users.**

Use Trane Rover Service Pack 4 when commissioning the FieldServer. This does not ship from Trane by default and may have to be requested from the local Trane representative.

When using Pre-Service Pack 4 software, you will be able to see the FieldServer in Rover, but none of the FieldServer variables will be available for binding even though they are present. Service Pack 4 has been tested to ensure that the variables show and the bindings work well.

### **Appendix A.11. Configuring a Network without LonMaker Binding (Explicit Addressing)**

All the Servers and their Clients need to be on the same domain to be able to communicate. See Appendix A.8 for further information.

If LonWorks device's Node ID is not known, it may be read using a utility program like NodeUtil or using a LonWorks Analyzer. All the Client Node CSV files need to have their Subnet\_ID and Node\_ID parameters set to point to their respective Server Subnet and Node ID values (see Node\_ID in section 4.4).

Once the FieldServers are restarted the network should function correctly.

### **Appendix A.12. External Interface File (XIF) generation**

After start-up the FieldServer creates a XIF (version 4.0) according to the configuration loaded. This file is called fServer.xif and can be uploaded from the FieldServer using the RuiNet utility.

The FieldServer's XIF file is internally generated by the LonWorks driver using the information contained in the FieldServer's configuration file (CONFIG.CSV). It is not possible to download an externally created XIF file using NodeUtil or LonMaker®. It is also not possible to download any type of externally created network variables default values file. The FieldServer's configuration can be changed by uploading and editing the CONFIG.CSV file, and therefore the XIF file must be obtained by uploading it from the FieldServer. Remember that this XIF file will change whenever the configuration file has been changed, downloaded and the FieldServer restarted.

### **Appendix A.13. Linking Configuration Properties with Configuration Network Variables**

Configuration properties are implemented on the FieldServer using configuration network variables. Configuration network variables take the form of update inputs in order to be updated as well as read by a network management tool. Each configuration network variable will have its own Map Descriptor. Since the data carried by a network variable is intended as a configuration property for other already declared non-configuration network variable(s), no Data Array needs to be assigned to its Map Descriptor.

Configuration properties can be declared to belong to the entire node, to an object(s) or to a network variable(s). This declaration defines the *scope* of the configuration property. Configuration properties that belong to an object shall be declared as a part of the object and not declared as a part of the node. Similarly a configuration property that is associated with a specific network variable(s) shall be declared as belonging to the network variable(s) and not the object or the node.

A configuration property's type and responsible Map Descriptor(s) are declared by the configuration network variable's self-documentation string as follows:

For linking to the entire node:

"&0,,0\x80,[SCPT Index]"

Example: "&0,,0\x80,20"

For linking to object(s):

"&1,[Object Index(s)],0\x80,[SCPT Index]"

Example: "&1,0.2.3,0\x80,23"

For linking to network variable(s):

"&2,[NV Index(s)],0\x80,[SCPT Index]"

Example: "&2,0.1.2.4.7,0\x80,20"

Where [SCPT Index] must be substituted by the relevant SCPT Index value from the following table. [Object Index(s)] is a list of LonMark object index(s) separated by points, while [NV Index(s)] is a list of network variable(s) separated by points.

| CONFIGURATION<br>PROPERTY | STANDARD<br>CONFIGURATION<br>PARAMETER<br>(SCPT'S) | EQUIVALENT<br>SNVT | SCPT<br>INDEX |
|---------------------------|----------------------------------------------------|--------------------|---------------|
| RANGE, MAXIMUM            | SCPTMAXRNGE                                        | SNVT_XXX           | 20            |
| RANGE, MINIMUM            | SCPTMINRNGE                                        | SNVT_XXX           | 23            |

Further examples of configuration network variables are presented in Appendix A.14

## Appendix A.14. Creating a LonMark Object

For more information on filling out the Node Self-Documentation String as well as the relevant Network Variable Self-Documentation Strings in order to create a LonMark Object please consult the following documentation from the LonMark Interoperability Association at [www.lonmark.org](http://www.lonmark.org)

Understanding LonMark Self-Documentation  
LonMark Application Layer Interoperability Guidelines

The two examples given below will show how LonMark Objects can be assigned in FieldServer configuration files:

The first example uses the standard Open Loop Sensor Object (Type 1) to create a Water Temperature Sensor that will send out its current status via Network Variable Updates. A typical recipient of these updates is given by example #2 which uses the LonMark Open Loop Actuator Object (Type 3) to create a Water Heating Element object that will interpret the Network Variable it receives and adjust power to its heating element accordingly.

**LonMark Config file Example #1 – Open Loop “Water Temperature” Sensor:**

```
// Client Side Map Descriptors
```

| Map_Descriptors      |                  |                    |               |           |            |             |              |               |               |                 |
|----------------------|------------------|--------------------|---------------|-----------|------------|-------------|--------------|---------------|---------------|-----------------|
| Map_Descriptor_Name, | Data_Array_Name, | Data_Array_Offset, | Lon_Function, | Function, | Node_Name, | SNVT_Index, | SNVT_Type,   | Nv_Min_Value, | Nv_Max_Value, | Nv_Selfdoc_text |
| nvoTemp,             | DA_FI_01,        | 0,                 | NVUOIMC,      | WRBC,     | LON_1,     | -,          | SNVT_Temp_f, | -,            | -,            | "@01;WaterTemp" |
| NviTempMin,          | -,               | -,                 | CFG_NVUI,     | Server,   | LON_1,     | -,          | SNVT_Temp_f, | 10,           | -,            | "&2,0,0x80,23"  |
| NviTempMax,          | -,               | -,                 | CFG_NVUI,     | Server,   | LON_1,     | -,          | SNVT_Temp_f, | -,            | 300,          | "&2,0,0x80,20"  |

The Node Self-Documentation String defines one LonMark object of type 1 – Open Loop Sensor.

These two configuration network variables will be linked to the first Map Descriptor declared. The NV\_Min\_Value and NV\_Max\_Value fields define the defaults for these CP's. These defaults are loaded by the FieldServer after a restart only when re-commissioning is required.

The object index is 0 and this Map Descriptor defines the 1<sup>st</sup> Network Variable of the object.

**LonMark Config file Example #2 – “Water Heating Element” Actuator:**

```
// Client Side Map Descriptors
```

| Map_Descriptors      |                  |                    |               |           |            |             |              |               |               |                 |
|----------------------|------------------|--------------------|---------------|-----------|------------|-------------|--------------|---------------|---------------|-----------------|
| Map_Descriptor_Name, | Data_Array_Name, | Data_Array_Offset, | Lon_Function, | Function, | Node_Name, | SNVT_Index, | SNVT_Type,   | Nv_Min_Value, | Nv_Max_Value, | Nv_Selfdoc_text |
| nvoTemp,             | DA_FI_01,        | 0,                 | NVUOIMC,      | WRBC,     | LON_1,     | -,          | SNVT_Temp_f, | -,            | -,            | "@01;WaterTemp" |
| NviTempMin,          | -,               | -,                 | CFG_NVUI,     | Server,   | LON_1,     | -,          | SNVT_Temp_f, | 10,           | -,            | "&2,0,0x80,23"  |
| NviTempMax,          | -,               | -,                 | CFG_NVUI,     | Server,   | LON_1,     | -,          | SNVT_Temp_f, | -,            | 300,          | "&2,0,0x80,20"  |

The Node Self-Documentation String defines one LonMark object of type 3 – Open Loop Actuator.

These two configuration network variables will be linked to the first Map Descriptor declared. The NV\_Min\_Value and NV\_Max\_Value fields define the defaults for these CP's. These defaults are loaded by the FieldServer after a restart only when re-commissioning is required.

The object index is 0 and this Map Descriptor defines the 1<sup>st</sup> Network Variable of the object.

## Appendix A.15. Combining explicitly addressed and bound network variables

To ensure undisturbed communication between the network management tool and the FieldServer during the commissioning, binding or monitoring processes, the timeouts of the explicitly addressed variables (Map Descriptors) might need to be set to values lower than the message timeouts used by the network management tool (LonMaker for Windows).

### LonWorks FieldServer Performance

| No | Description                                                                                                              | Min | Typ | Max | Units         |
|----|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|---------------|
| 1  | FieldServer startup time with 4096 network variables                                                                     | -   | 6.5 | -   | Minutes       |
| 2  | Time to commission FieldServer with 4096 network variables                                                               | -   | -   | 40  | Minutes       |
| 3  | Time to complete a network variable updFieldServersbetween two FieldServers (acknowledged service)                       | -   | 40  | -   | Milli-seconds |
| 4  | Time to complete a networkFieldServersoll message between two FieldServers (request/response service)                    | -   | 125 | -   | Milli-seconds |
| 5  | Time to complete a network manageFieldServers variable fetch message between two FieldServers (request/response service) | -   | 125 | -   | Milli-seconds |

## Appendix A.16. Node Status Operation

When binding network variables on the FieldServer, the node status will be on-line before binding as well as after un-binding network variables. A node will go off-line only when a bound network variable of that node goes off-line (e.g. is disconnected).

## Appendix A.17. Network Management Fetch Function

Normally one would use a NVPIEXC to perform the polling (RDBC) function if required, but it has the limitation that data can only move in one direction (Server to Client). The added functionality of a Write-through was added to the network management fetch command (NMFETCHC) to provide movement of data back to the polled node. This means that should the data in the Data Array linked to a NMFETCHC Map Descriptor change by another process, that the data will be propagated to the polled node by means of a network variable update.

Another useful feature of the NMFETCHC function is that it can perform reads to any other type of node function (NVUI, CFG\_NVUI, NVUOEXX, NVPIIMC, etc.) This means that even Client Map Descriptors can be read this way.

Network management fetch requests received on polled nodes are handled differently from normal NV Poll requests. The response to a NV Poll will contain valid data. Data is valid if the node that is the source of the data is online and if this data is not too old. The data in the response to a network management fetch will not be checked for validity, however, it will simply respond with the current data in the Data Array.

### Appendix A.18. Service types currently supported for network variable messages

Currently the service type for network variable update messages is fixed to acknowledged service. Request-response service is used for network variable poll and network management fetch messages.

### Appendix A.19. Spaces in Network Variable Names

Due to the difficulties encountered with spaces and other 'illegal' characters used in network variable names (Map Descriptor names), the driver will automatically replace all spaces and illegal characters in names with underscores at startup. Illegal characters differ according to the Network Management Software being used. The correct rule set for illegal characters will be selected by the connection\_type connection parameter.

The following characters are illegal for the stated Connection\_Types:

- **LonMaker®**, LonWatcher, None - Whitespace
- Circon\_SI – Whitespace, %, -

In addition, the maximum number of Network Variables under Circon\_SI is limited to 255 per node.

### Appendix A.20. SNVT\_Option Field

This field can be used to isolate a specific record within a complex SNVT. Appendix A.21 and Appendix A.3 show which SNVTs are currently attributed with SNVT\_Option capabilities.

### Appendix A.21. SNVT\_Units Field

The measurement units of a SNVT is fixed as far as it is transported across the LonWorks network, but by the setting of the SNVT\_Units field it is possible to specify how the data is made available in Data Arrays. For example SNVT\_temp\_f is always transported across the LonWorks network as degrees Celsius, but by setting the SNVT\_Units field to Deg\_F the measurement units of the Map Descriptor's data will be set to degrees Fahrenheit. The following table shows which SNVT's currently have SNVT\_Units capabilities.

**Note:** In the table below **bold** marks the default setting except for ***bold italics***, which take precedence as the default if the point is mapped to a floating point Data Array.

| SNVT_Type       | SNVT_Option     | SNVT_Units | Length | Measurement Units       |
|-----------------|-----------------|------------|--------|-------------------------|
| SNVT_press_f    | N/A             | Inch_H2O   | 1      | Inches of water         |
| SNVT_press_p    | N/A             | Inch_H2O   | 1      | Inches of water         |
| SNVT_temp       | N/A             | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
| SNVT_temp_f     | N/A             | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
| SNVT_temp_p     | N/A             | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
| SNVT_switch     | All             | Raw        | 2      | Raw, unadjusted data    |
|                 | Value           | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Percent    | 1      | Percent (%)             |
|                 | State           | Raw        | 1      | Raw, unadjusted data    |
| SNVT_temp_setpt | All             | Raw        | 12     | Raw, unadjusted data    |
|                 |                 | Deg_C      | 6      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 6      | Degrees Fahrenheit (°F) |
|                 | Occupied_cool   | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
|                 | Standby_cool    | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
|                 | Unoccupied_cool | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
|                 | Occupied_heat   | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
|                 | Standby_heat    | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |
|                 | Unoccupied_heat | Raw        | 1      | Raw, unadjusted data    |
|                 |                 | Deg_C      | 1      | Degrees Celsius (°C)    |
|                 |                 | Deg_F      | 1      | Degrees Fahrenheit (°F) |

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## Appendix B. Troubleshooting Tips

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### Appendix B.1. Debugging a LonWorks connection: Hints and tips

- To test connections, put your configuration tool into a mode that will display service requests, and then push the button on the FieldServer. A request should appear.
- In order for variables to appear as outputs, they need to be declared as write variables in the FieldServer. Declaring the Map Descriptor functions as WRBC, or WRBX can do this. See Appendix A.1 for more information.
- If the domain and Subnet ID are defined in the configuration file of the FieldServer, these values will be used when power is cycled to the FieldServer. If the values set here are different to what the Network Manager has set up for the FieldServer for clients using implicit addressing, the FieldServer will stop communicating. In this case either change these settings or remove them from the configuration file completely and recommission the FieldServer.

### Appendix B.2. Error Message Lonlive.c 121

If the following error message is returned:

```
DRIVER-> LON : Error, timeout while waiting for Lon I/F to reset!----- Configuration Error -----
```

It is possible that the FieldServer hardware in use may not support LonWorks, or the firmware loaded contains LonWorks but is the wrong firmware for the application. Remove LonWorks from the configuration or get new firmware/hardware.

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